



Crowdsourcing environmental sustainability: Where 2.0 Australia?

Implications of GeoWeb 2.0 for broad-based community participation in environmental information sharing

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Front matter

1.1 Declaration

This thesis is an uncorrected text as submitted for examination. This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed:

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28 September 2015

Revised January 2017

1.2 Statement of Co-Authorship

The following publication was produced as part of this thesis:

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Dedication

For my father, Leslie George Allen Clark

28/6/1927 - 11/10/2014

for providing the opportunity for the education he never had,

a love of ideas, science, a social conscience, understanding and acceptance, and

taking me fishing.

Abstract

This thesis investigates the potential of GeoWeb 2.0, the interactive geospatial capabilities of the internet, to facilitate broad-based community participation in environmental information sharing and environmental management. Environmental sustainability is a challenge confronting the whole of humanity. Creation and sharing of information is foundational in efforts to address environmental sustainability. GeoWeb 2.0 and related practices, such as volunteering geographic information and Neogeography, have been heralded as a revolution in information sharing, with potentially transformational and disruptive consequences. GeoWeb 2.0 is already being harnessed for information sharing to support environmental sustainability efforts. However, this capacity brings both opportunities and risks hence applications of GeoWeb 2.0 deserve close examination.

Action Research was used to engage with research participants, as individuals and in small groups in the researcher's local community and within institutions operating at larger scales, in both online and offline contexts. Participant Action Research was first used to engage with individuals on and offline to share information about the state of their environment. Action Research and Participant Observation were used to engage with other existing initiatives and organisations to investigate their use of GeoWeb 2.0. I participated directly in the study, including an auto-ethnographical study of my own practice. Other evidence was gathered from the literature, web resources and applications. A broad range of criteria for quality were established and critical reflexivity employed throughout the research. A narrative writing style was used to make explicit the recursive development, and the role of time and place, in construction of the research.

Issues with traditional environmental information sharing that can be addressed through GeoWeb 2.0 were identified through a discussion of environmental sustainability, its information requirements, issues with State of the Environment reporting, and GeoWeb 2.0 capabilities. GeoWeb 2.0 can lower barriers to community sharing of environmental information, and has potential for addressing the issues identified for environmental information sharing. This research indicated, however, that the potential may be difficult to achieve as many barriers to participation exist and are emerging, and that broad-based sharing was not identified, demonstrated or considered likely through GeoWeb 2.0 alone. While it is possible that GeoWeb 2.0 can contribute to the representation of pluralistic conceptualisations

of environmental sustainability that are nuanced to particular contexts, a definitive evaluation is confounded by the potential for the emergence of unintended consequences from complex interactions at broader scales.

This research contributes to a more complex and nuanced understanding of GeoWeb 2.0's role in supporting community sharing of information that promotes environmental sustainability. It critiques dominant views espousing simplistic and deterministic views of the outcomes for GeoWeb 2.0, in particular that openness is a major characteristic. In some instances, openness is an objective and features that contribute to this can be identified, but it is a concept that is conditional on the local context. Other quality criteria should be used to evaluate any approach that considers using GeoWeb 2.0 including inclusive, representative, accessible, transparent, free, equitable, balanced (ing), collaborative, adaptable and reusable.

An insight arising from the research is that Action Research methods can contribute to the development of GeoWeb 2.0 applications that share environmental information in support of sustainability. This is because its recursive nature is responsive to the complexity of the evolving context, and critical reflexivity allows for continual assessment of ethical concerns arising from emergent outcomes. Practically, the research reviews and demonstrates how GeoWeb 2.0 can be used by individuals and collectives to discover and share relevant information, and how this can affect real changes in environmental conditions.

Contents

FRONT MATTER.....	2
1.1 DECLARATION.....	2
1.2 STATEMENT OF CO-AUTHORSHIP.....	3
1.3 ACKNOWLEDGMENTS.....	4
ABSTRACT	5
CONTENTS	7
1.4 FIGURES	11
1.5 TABLES.....	14
1.6 GLOSSARY.....	15
PREFACE: SITUATING THE RESEARCH AND RESEARCHER (PRE-2011)	16
CHAPTER 1 THE WORLD IN OUR HANDS? (2011)	19
CHAPTER 2 WEB 2.0, GEOWEB 2.0 AND ENVIRONMENTAL SUSTAINABILITY	26
2.1 WEB 2.0 AND GEOWEB 2.0	26
2.1.1 O'Reilly's Web 2.0	27
2.1.2 GeoWeb 2.0 = GeoWeb + Web 2.0	29
2.1.3 Implied and explicit openness	32
2.2 ENVIRONMENTAL SUSTAINABILITY.....	34
2.2.1 Interconnections, dynamism and complexity.....	35
2.2.2 Multiple scales, urgency, contention and conflict.....	38
2.3 ENVIRONMENTAL MANAGEMENT AND INFORMATION	39
2.3.1 Information is never free.....	42
2.3.2 Requirement for participation, and openness	43
2.4 RISKS AND ETHICAL CONCERNS	45
2.5 SUMMARY	46
CHAPTER 3 METHODOLOGY 1: ENGAGE AND CO-CREATE.....	48
3.1 METHODOLOGICAL INFLUENCES	48
3.2 ACTION RESEARCH, PARTICIPANT ACTION RESEARCH	50
3.2.1 Rigour, validity and quality in AR and PAR	53
3.2.2 PAR's recursive cycles	55
3.2.3 PAR and participatory GIS.....	58
3.3 PARTICIPATION, REFLEXIVITY AND ETHICS	59
3.3.1 Researcher influence and reflexivity	59
3.3.2 Recruitment of participants	61
3.3.3 Ethics and risks of participation	63
3.4 ONLINE PARTICIPANT ACTION RESEARCH	64
3.4.1 The State of Our Environment.....	65

3.4.2	<i>Participating in the SoOE</i>	66
3.4.3	<i>Data collection and direction</i>	67
3.5	SUMMARY	70
CHAPTER 4 ONLINE WIKIS AND MAPS (EARLY 2011)		72
4.1	PAR 1: CREATING THE SoOE	72
4.1.1	<i>Inviting collaborators</i>	79
4.1.2	<i>Offline participation</i>	85
4.1.3	<i>Reflections: on simplicity and complexity</i>	86
4.2	PAR 2: ONLINE AND OFFLINE COLLABORATION	89
4.2.1	<i>My online participation</i>	89
4.2.2	<i>Online participation</i>	91
4.2.3	<i>Offline participation</i>	96
4.2.4	<i>Reflections on participation</i>	97
4.3	PAR 3: EMERGING TECHNICAL LIMITS	100
4.3.1	<i>My Online Participation</i>	100
4.3.2	<i>Online participation</i>	103
4.3.3	<i>Offline participation</i>	106
4.3.4	<i>Reflections: openness, leading and the GeoWeb</i>	108
4.4	SUMMARY	110
CHAPTER 5 WIDER PARTICIPATION AND PERSPECTIVES (LATE 2011)		113
5.1	PAR 4: CHALLENGING AND CHANGING WORLDVIEWS	113
5.1.1	<i>My Online participation</i>	113
5.1.2	<i>Offline participation: creative commons and communicating</i>	116
5.1.3	<i>Reflections: disciplines, certainty and communication</i>	118
5.2	PAR 5: EMERGENT METHODS AND PERSPECTIVES	124
5.2.1	<i>My online participation</i>	124
5.2.2	<i>Offline participation: concerns and interests</i>	125
5.2.3	<i>Reflections: Methods and describing GeoWeb 2.0</i>	128
5.3	PAR 6: BEYOND THE SoOE	133
5.3.1	<i>Diversity of GeoWeb 2.0</i>	133
5.3.2	<i>Quality and context</i>	135
5.3.3	<i>Australian context</i>	137
5.3.4	<i>Reflections</i>	139
5.4	SUMMARY	139
CHAPTER 6 REVIEW, REFLECTION, METHODOLOGY 2 (2011/12)		142
6.1	GEOWEB 2.0 POTENTIAL FOR SHARING INFORMATION	142
6.2	FACTORS AFFECTING PARTICIPATION	145
6.3	VALUE OF GEOWEB 2.0 USE FOR ENVIRONMENTAL SUSTAINABILITY	148

6.4	CHANGING WORLDVIEW AND APPROACH	151
6.5	ETHICS, INFORMED CONSENT AND NATURALISTIC ENQUIRY.....	157
6.6	SUMMARY	160
CHAPTER 7	STAGE 2: BOTTOM-UP APPROACHES (2012/13)	161
7.1	COMMUNITY ENVIRONMENTAL GROUPS.....	162
7.2	CROWDSOURCING THE WEATHER.....	165
7.3	STATE OF THE ENVIRONMENT REVIEWS.....	167
7.4	SOUTH HOBART SUSTAINABLE COMMUNITY GROUP.....	171
7.5	USING WESTERN AUSTRALIA’S EARS.....	176
7.6	GOVHACK 2013.....	182
7.7	SUMMARY: BOTTOM UP POTENTIAL	185
CHAPTER 8	STAGE 2: TOP-DOWN INITIATIVES (2012/13).....	187
8.1	SENSET: TASMANIA’S SENSOR NETWORK.....	187
8.2	AUSTRALIAN CROWDSOURCING RESEARCH.....	194
8.2.1	<i>Key people, stakeholders and authorities</i>	<i>196</i>
8.2.2	<i>Whose credibility and who controls?</i>	<i>198</i>
8.2.3	<i>Semantic Web and SDI development in Australia</i>	<i>202</i>
8.2.4	<i>CRCIS Summary.....</i>	<i>204</i>
8.3	SENSET DEVELOPS	205
8.3.1	<i>A key informant’s perspective.....</i>	<i>205</i>
8.3.2	<i>Digital disruption is good - just believe it!.....</i>	<i>210</i>
8.4	TOP DOWN TENTATIVE ENGAGEMENT	213
8.5	SUMMARY	214
CHAPTER 9	FURTHER DISCUSSION AND SYNTHESIS (2013/14)	216
9.1	OPENNESS AND INTERACTIVITY REVISITED	216
9.2	AUSTRALIAN RESEARCH AND APPLICATIONS	217
9.2.1	<i>Diverse terminology</i>	<i>218</i>
9.2.2	<i>GIS and Social media converge</i>	<i>221</i>
9.2.3	<i>Broader environmental applications.....</i>	<i>223</i>
9.3	GEOWEB2 POTENTIAL FOR SHARING INFORMATION	226
9.3.1	<i>Revolutionising information management capabilities.....</i>	<i>226</i>
9.3.2	<i>Connecting and collaborating.....</i>	<i>228</i>
9.3.3	<i>Information availability, accessibility and integration.....</i>	<i>230</i>
9.4	BARRIERS TO BROAD PARTICIPATION.....	232
9.4.1	<i>Resources and risks</i>	<i>232</i>
9.4.2	<i>Attitudes, culture, leadership, and relationships</i>	<i>235</i>
9.4.3	<i>Structures.....</i>	<i>237</i>
9.5	VALUE OF GEOWEB 2.0 USE FOR ENVIRONMENTAL SUSTAINABILITY	237

9.5.1	<i>Qualifying openness and democratisation</i>	238
9.5.2	<i>Whose information and sustainability?</i>	240
9.6	COMPLEXITY, COMMERCIAL INTERESTS AND CONTROL.....	243
9.7	ON METHODOLOGY	247
9.7.1	<i>Change, research position and boundaries</i>	249
9.8	SUMMARY	250
CHAPTER 10	CONCLUSIONS (2014/15)	252
10.1	ENVIRONMENTAL SUSTAINABILITY AND GEOWEB 2.0	252
10.2	ACTION RESEARCH AND FUTURE RESEARCH	257
ADDENDUM (2016)	259
REFERENCES	262
A1 APPENDIX	286

1.4 Figures

Figure 1-1: The world in our hands – smart phone with Google Earth digital globe	19
Figure 1-2: Timeline showing development of the Web	21
Figure 2-1: Google Trends searches for the terms Web 2.0 (blue), Social media (red) and New media (yellow).....	27
Figure 2-2: The “Open GeoWeb 2.0”	30
Figure 2-3: The Adaptive Cycle	37
Figure 2-4: Relationships between data, information, knowledge and wisdom	40
Figure 3-1: Participant Action Research process of recursive cycles	55
Figure 3-2: Adaptive Environmental Management process diagram	57
Figure 4-1: Home page of the SoOE Wiki.....	73
Figure 4-2: SoOE Wiki Statistics Overview page, summary for 2011	74
Figure 4-3: “About” page describing the research.....	75
Figure 4-4: SoOE Map.....	76
Figure 4-5: Descriptive panel on SoOE Map showing number of collaborators and views, August 2014.	77
Figure 4-6: Adding photographs to locations in the SoOE Map	78
Figure 4-7: SoOE Map site “Significant tree – old Eucalyptus viminalis”, with link to youtube video of birds in the tree	79
Figure 4-9: SoOE Wiki unique visitors, first month up to 21/3/2011	80
Figure 4-10: SoOE Wiki visitors by country of origin (per cent), up to 21 March 2011	82
Figure 4-11: SoOE Wiki visitors to each page ordered by date created.	83
Figure 4-12: SoOE Wiki messages, PAR 1	83
Figure 4-13: Online interaction regarding the “Senecio” polygon	84
Figure 4-14: Visits to the SoOE Map	85
Figure 4-15: Cynefin complexity framework with all five domains	87
Figure 4-16: SoOE Map site “Sentinels of bus stop 68”	92
Figure 4-17: Statistics collected by the SoOE Wiki up until 25 May 2011.....	93
Figure 4-18: Summary of visits to each Wiki page for selected dates.....	94
Figure 4-19: SoOE Map Site 31, location of drain on Lindisfarne Bay	101
Figure 4-20: SoOE Map site 33, location uphill of discharge point also with consistent water flows.....	101
Figure 4-21: Demonstration of how to link to a document from SoOE Map	102
Figure 4-22: Sea Level Rise Coastal Erosion document opened using hyperlink.....	103
Figure 4-23: SoOE Wiki usage statistics for PAR 3.....	104

Figure 4-24: SoOE Wiki notice regarding visitors including search engines and “other crawlers”	105
Figure 4-25: Percentage of visitors to the SoOE wiki by country of origin for the months of June, July and August 2011	106
Figure 4-26: KML button in Google MyMaps that allows data from the map to be downloaded to the local computer	107
Figure 4-27: Research journal page 96, 7 July 2011	109
Figure 5-1: Wikimapia with user assigned categories	114
Figure 5-2: Eucalyptus camaldulensis image from IAN used for icon in SoOE Map.....	115
Figure 5-8: Last photo of complete poster at 12:36 on 2/9/2011	117
Figure 5-9: Research journal pages 122- 123, highlighted areas transcribed as quotations ..	122
Figure 5-10: Journal page 180, 17 October 2011	123
Figure 5-14: FeralScan data quality issues with rabbit occurrences off Tasmania’s coast ...	128
Figure 5-15: Active Wikipedians, number of volunteers, 2001-2015, depicting plateauing of growth in participation.....	131
Figure 5-17: TripAdvisor overall reviews by visitors to a hotel, showing ability to segregate by broad types of Families, Couples, Solo or Business travellers	136
Figure 5-18: As above showing ratings for Families	137
Figure 7-1: Comments on Youtube pardalote video viewed at Landcare group meeting	164
Figure 7-2: SHSC web site with corrected Food Map embedded	173
Figure 7-3: Oysters listing on Urban Food Map in area contaminated by heavy metals.....	174
Figure 7-4: Warning added to Geilston Bay oysters.....	175
Figure 7-5: Site Plan for Boral Transport’s Seven Mile Hill Mine near Kalgoorlie, WA.....	177
Figure 7-6: Google MyMap with the Seven Mile Hill Mine location outlined, showing pop-up text box with link to the EARS site listing.	179
Figure 7-7: ArcGIS.com view of Tasmanian spatial data provided through web services ...	184
Figure 8-1: Front cover of initial SenseT brochure, June 2012.	189
Figure 8-2: Second page of SenseT brochure, June 2012.....	190
Figure 8-3: Spatial Data supply chain figure used in the CRCSI Research Strategy	200
Figure 8-4: Semantic Web diagram used in the CRCSI Research Strategy	201
Figure 8-5: CRCSI report diagram showing Australian and New Zealand SDI development in relation to wider internet developments.....	203
Figure 8-6: SenseT website home page imagery - smiley farming family	206
Figure 8-7: SenseT webpage - happily holding healthy oysters.	207
Figure 8-8: Google Trends search for use of the term “Web 2.0”,	208
Figure 9-1: QuakeMap Nepal earthquake crowdsourcing interface	244
Figure 9-2: Tomnod crowdsourcing interface for Nepal earthquake.....	245

Figure A-1: Standard email invitation to collaborate from the SoOE My Map	286
Figure A-2: Information provided on ways people could participate.....	288
Figure A-3: SoOE Map “Invite collaborators” panel.	289
Figure A-4: SoOE Wiki, Water page, first writing (more below is later addition)	289
Figure A-5: Journal page 99, 12 July 2011, trialling different GPS software	291

1.5 Tables

Table 3-1: Number of participants in each stage, capacity or context of participation and areas of interest and expertise.....	62
Table 3-2: SoOE update reports and date distributed.	69
Table 4-1: SoOE Wiki visitors to each page in PAR 1.....	82
Table 4-2: Wiki statistics with instances of unique visitors greater than views highlighted ...	95
Table 4-3: Visitors to the SoOE Wiki by country of origin.....	96
Table A-1: List of SoOE wiki pages with PAR cycle and date created	286
Table A-2: List of SoOE Map sites created in PAR 1	287
Table A-3: SoOE Map sites added in PAR 2.....	290
Table A-4: Sites added to the SoOE Map in PAR 3	291
Table A-5: SoOE Wiki files created in PAR cycle 4.....	292
Table A-6: Site added to SoOE Map in PAR 4	292
Table A-7: Files added to the SoOE wiki in PAR 5	292
Table A-8: Site added to the SoOE Map during PAR 5	292

1.6 Glossary

app	Application for smart phones
AR	Action Research
BOM	Bureau of Meteorology
CAS	Complex Adaptive System
CC	Creative Commons
CRCSI	Cooperative Research Centre for Spatial Information
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIPWE	(Tasmanian) Department of Primary Industries, Parks, Water and Environment
FOSS	Free and Open Source Software
FGW2S	Free Web 2.0 Services (Web 2.0 includes GeoWeb 2.0, Social Media etc.)
GIS	Geographic Information Systems
GPS	Global Positioning Systems
KML	Keyhole Markup Language
LBS	Location Based Services
P2P	Peer to Peer
PAR	Participatory Action Research
PGIS	Participatory GIS
PPGIS	Public Participation GIS
PSMA	Public Sector Mapping Agency
SaaS	Software as a Service
SDI	Spatial Data Infrastructure
SES	Spatially Enabled Society
SNS	Social Networking Services
SOE	State of the Environment (with reference to SOE Reporting)
SoOE	“State of Our Environment”, name of free web 2.0 services adapted by author
theLIST	Land Information System Tasmania
UGC	User Generated Content
VGI	Volunteered Geographic Information

Preface: Situating the research and researcher (pre-2011)

This preface provides a short history of my relationship with environment and technology. Following Mansvelt and Berg's (2010) advice I seek to locate the thesis and knowledge by locating myself as researcher and writer within the writing; to establish and make transparent the time and place of observation, and the personal lens through which I observe (Anderson, Adey & Bevan 2010; Waitt 2010). In chronological order, I describe my evolving understanding and related developments in technology and environmental management, to convey a sense of the origins, trajectory and direction of the research. This evolution through time is a central organising principle of the thesis. This preface is also meant to convey a sense of progress in scales of focus, from micro scales, through to meso to macro scales, and the influence of each on the other.

My research is about the relationship between people – us, and our environment and technology. I am a digital immigrant. My schooling predates desktop computers, but only just. In 1981 my school purchased its first (and only) desktop computer. Two years later, taking undergraduate computer science, I punched cards for a mainframe computer that took up a whole floor, and then moved on to compiling programs in Pascal and Fortran. Though assured by the teachers that “one-day people wouldn’t have to be able to program to use computers”, it was all too esoteric for this impetuous youth, and I left to do practical hands-on environmental work.

Throughout the 1980s I collected seeds, planted trees, poisoned weeds, laying – although I didn’t know it then – practical foundations for an environmental management career. Strong memories from these days are observations of how on-the-ground conditions, for example species, their distributions and numbers, often did not correlate with the information used by those who directed the work. Their information was summarised, generalised or sometimes just plain wrong. I prided myself on knowing “the way things really were” and adapted their directives accordingly.

Back finishing my studies in the early 1990s, I took a unit in Geographic Information Systems (GIS), the first time offered, and instantly recognised its power. Again, I was too impatient. Software such as ArcInfo could only be driven by command lines, so I returned to “the field”.

Working in Darwin as coordinator of a Landcare group rehabilitating a creek catchment, the relevance of people and community participation was heartbreakingly brought home. Passionate about the vision the group and I had for the creek, I worked long hours tending plants, fixing broken and vandalised irrigation systems, before and after other work. One day a plume of smoke appeared in the upper catchment and, gauging the wind, I knew much of our work would be burnt. Indigenous land managers had a different vision for the creek and the power, through their technology of fire, to enact that world view. We all have different perspectives on what is right. Where individuals and groups have the power to enact their world view, community involvement, participation and co-ordination become essential so as not to negate or ruin each other's work.

Next decade I am managing all the environmental issues, heritage, biodiversity, contamination, bushfire, resource efficiency, over an estate of 13 properties and 35,000 hectares. I need good information and know this must include information about the environment, what people think and are doing. Remembering GIS, I turn to studies in Spatial Information Science and find it has progressed in leaps and bounds. Desktop GIS is far easier to use and with the advent of web-based GIS such as that spearheaded by Google Earth and Maps, GIS is available and usable by almost anybody with internet access. The same is true for other software, and I am starting to believe that my teachers back in the early 1980s were right, although perhaps even they could not have imagined the totality and pace of change in computers and the internet over the last thirty years. Over this time the need for effective environmental management has similarly increased, and the role of information and community participation has remained pivotal.

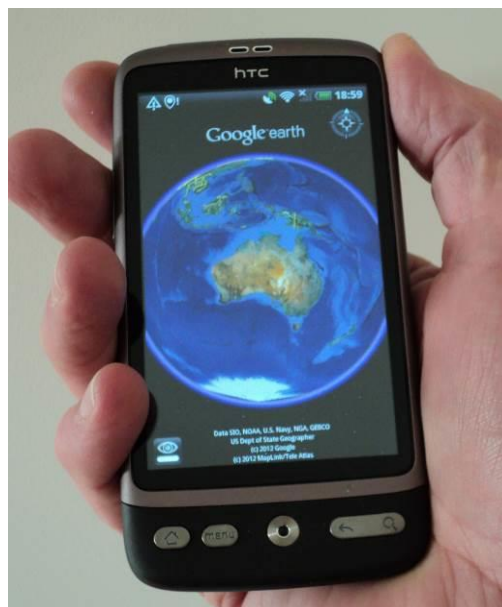
This research originates from my involvement in environmental management over the last 30 years, first-hand experience of the issues and challenges involved, and my more recent observation of technological changes that present an opportunity to address these issues and challenges. This is a time over which I have come to realise the importance of information of multiple types, about the environment being managed, its wider context, what people are doing and how they value the environment. This includes scientific "facts" as well as other observations and perspectives. Discovering and interpreting the relevant information, understanding the implications of inevitable uncertainty, incorporating how others may see differently, all in a timely manner is often very challenging.

I have watched with fascination over the last ten years the emergence of the interactive and geospatial capabilities of the internet. Authors such as Howe (2006; 2008), Shirky (2008, 2010), and Tapscott and Williams (2008) consider this heralds a paradigm shift in the way society is organised. If so this interactivity, coupled with emerging online geospatial capabilities, also poses significant opportunities in the quest for sustainability. There are, however, major issues relating to the world views and structures it supports (Elwood, Schuurman & Wilson 2011), the potential for anti-social use, and hence how it is shaped by and “inexorably shapes the society within which it exists” (Warren 2011, p.71). Enthusiasm for the possibilities should be prudently tempered with careful investigation.

Chapter 1 The World in Our Hands? (2011)

It's early 2011 and I ask what do people have in their hands these days that is so engaging? Look around and you see them. Heads bent, intent on something in one hand, over which the other is waving back and forth, now and then poking, jabbing. They look like magicians about to conjure up some amazing trick. In a way, they are. Get closer and you see the subject, a little gadget you recognise as a smart phone (Figure 1-1). They are extremely powerful computers, sensors and communication devices that put digital representations of the world into our hands, as part of the emerging Web 2.0 and GeoWeb 2.0.

Figure 1-1: The world in our hands – smart phone with Google Earth digital globe



(Source: author's photograph 2011)

Academics such as Shirky (2008, 2010) and Macnamara (2010) and industry leaders such as Google's Schmidt and Cohen (2013) describe the technological developments and related practices of which GeoWeb 2.0 is a part as akin to a revolution in human communication, and one that is only just underway. In books such as 'The 21st Century Media Revolution' and 'The New Digital Age', they attribute the significance to disruptive and transformative powers, with major positive and negative societal impacts. The former include the creation of new economic opportunities (Anderson 2006; Tapscott & Williams 2008), improved disaster responses (Goodchild & Glennon 2010; Harvard Humanitarian Initiative 2011), and the democratisation of information (AGIMO 2009; Goodchild 2007a; Kaplan & Haenlein 2010; Warf & Sui 2010).

Negative impacts associated with Web 2.0 include disruptions to society and government, civil unrest and the demise of extant industries. (Keen 2008; Macnamara 2010; Morozov 2011; Morozov 2013; Schmidt & Cohen 2013).

Concurrent with this unfolding technological revolution is an environmental crisis. Humanity's technological advancement and population are changing the planetary environment at an unprecedented scale and pace. Human induced global climate change is arguably the ultimate manifestation of this (Flannery 2005; IPCC 2014). There is evidence that our impacts are having dire consequences for the planet's other life forms and life support systems, upon which we ultimately rely (WWI 2011). The ability of humans to influence the earth system has led to the naming of this age as the Anthropocene (Crutzen 2006), an age in which humans are the dominant planetary engineers. Our technology is one of the prime enablers of this capability (Lovelock 2014).

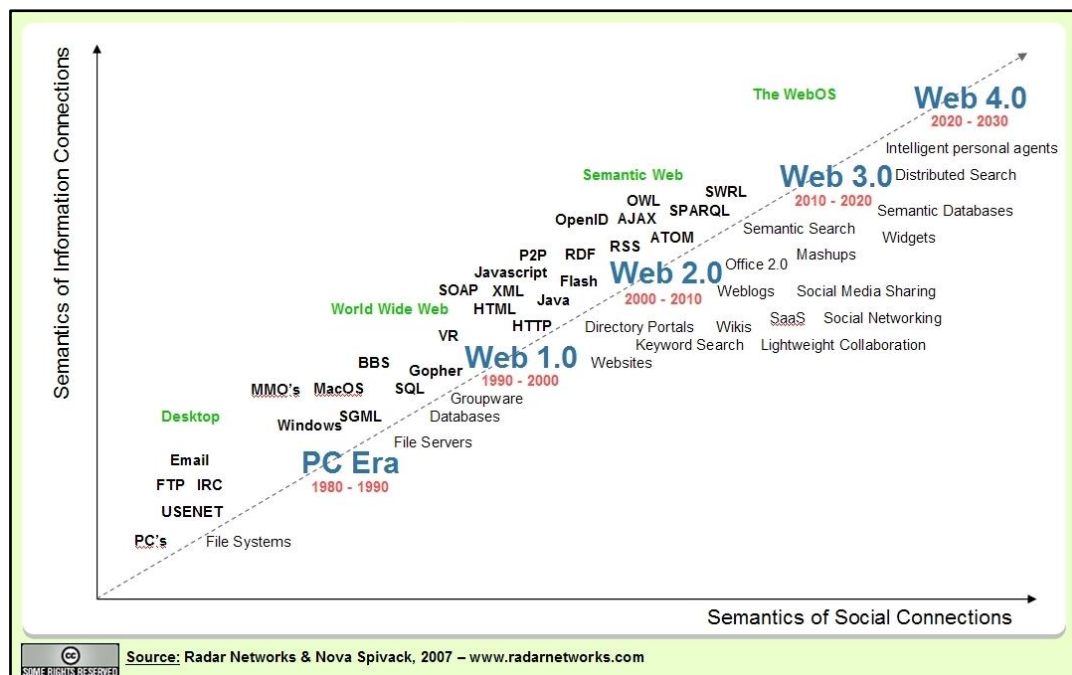
This project is situated at the intersection of this time of technological revolution and unfolding environmental crisis. It is an investigation into the implications, and the possible harnessing, of this technological revolution towards addressing the environmental crisis, focussing on two main areas. Firstly, it is the emerging interactive capabilities and participatory practices of the internet that are of primary interest due to the potential to support broad-based community participation. The term Web 2.0 is adopted as best describing the manifestation of the internet in which this became widespread. Secondly, developments in spatial technologies are of interest due to the importance of the spatial dimensions of information relevant to environmental management and sustainability. To describe the intersection of the participatory internet, Web 2.0, and its geospatial capabilities, the term GeoWeb 2.0 is adopted.

It is acknowledged there are many different names for each and contentions about validity. Claims that the GeoWeb 2.0 and related practises are transformative raise the possibility that this constitutes an example for information organisation and sharing of one of Kuhn's (1970) scientific revolutions. This suggests a new paradigm is emerging not through a logically determined process but rather through a dynamic and perhaps messy mix of scientific efforts, sociology and passion. The importance of considering the technical and social aspects of this technological revolution requires its conceptualisation as a socio-technological phenomenon. For the purposes of this thesis, any application of GeoWeb 2.0 that deals with environmental issues, information, management or sustainability is relevant. However, to manage scope and

due to the interconnectedness and complexity of environmental sustainability issues, rather than single out one theme or aspect, I focus on my local context and application.

The advent of Web 2.0 and GeoWeb 2.0 means that those with internet access can use what Anderson (2007, 2012) refers to as Web services¹, to share information with whomever they want almost immediately. The social and geographic context of the information can be made explicit. Often it is not, and cannot be, mediated by partisan interests. Once shared, the information is also persistent. This ability is attributed to the increasing ease of use of digital technologies, interactivity and openness. Goodchild (2007a, p.214) expresses the impact for geographic information representation with the statement “the creation of a ‘fly-by’ was previously one of the more sophisticated GIS tasks, it is now possible for a child of ten to create one in ten minutes”. These changes are very new: Figure 1-2 shows Web 1.0 occurring between 1990 and 2000 and Web 2.0 from 2000 to 2010, emerging after the dot.com crash in late 2000 (Anderson 2007).

Figure 1-2: Timeline showing development of the Web



Source: (Spivack 2007)

¹ Also known as Social media, GeoWeb 2.0 services, and Location Based Services (LBS)

The current era is designated as Web 3.0. This diagram is dated 2007, and hence was then only predictive past 2007. This figure is also used in the Co-operative Research Centre for Spatial Information research strategy report discussed in Chapter 8 (West 2012), hence it is considered significant. It is not until 2005, however, that Web 2.0 becomes prominently visible, or at least widely referred to as Web 2.0, following O'Reilly's (2005) seminal paper.

GeoWeb 2.0 also gained widespread prominence around 2005, largely attributed to the launch of Google Maps and Google Earth (Boulos 2005; Butler 2006; Miller 2006). Earlier developments in the late 1990s and early 2000s such as online maps or geo-browsers, the freeing up of the GPS signals, and open geospatial standards, laid the foundations for this emergence (Haklay, Singleton & Parker 2008). GeoWeb 2.0 is a very recent phenomenon that has delivered digital representations of the physical world to our desktop computers (The Economist 2007) and then into our hands, through the evolution of smart phones and tablet computers. Through GeoWeb 2.0, we can find and view these digital representations, contribute by volunteering our own geographic information (Goodchild 2007a) and help organise and curate information and other resources (De Longueville 2010; Liu 2010).

Macnamara (2010), Sui, Goodchild et al. (2012), and Schmidt and Cohen (2013) emphasise the rate of increase in size and complexity of the internet, and its increasing spread both geographically and demographically. Quiggan (2013, p.10) cites McKinsey, the World Bank and Organisation for Economic Co-operation and Development (OECD) as estimating that the internet accounts for 20-30% of GDP growth. The benefits from this are however not evenly distributed across the globe; there are considerable geographic and demographic differences in rates of access, participation, literacy and understanding (Sui, Goodchild & Elwood 2012).

The implications of this revolution for the concurrent unfolding environmental crisis deserve consideration as this confluence could be placing the world in our hands. That is, the hands of those with access and the power to use this technology. There are considerable opportunities afforded by the emerging technological revolution, but also considerable risks and ethical challenges. The potential for disastrous outcomes means understanding this phenomenon, and knowing how to use it well, is critical. This is overall rationale for my research.

Mason (2002) recommends setting research out as a puzzle, consisting of an overarching research question containing a number of objectives that address fundamental premises of implementation. The overall aim of this thesis is:

To investigate the potential of the interactive geospatial capabilities of the internet, GeoWeb 2.0, for facilitating broad-based community participation in environmental information sharing and environmental management.

The following objectives were initially set to fulfil this aim:

1. identify issues with traditional environmental information sharing that can be addressed through GeoWeb 2.0
2. assess the potential of free GeoWeb 2.0 services (FGW2S) for community-based sharing of environmental information
3. determine factors influencing participation and use of GeoWeb 2.0 by the broader community and
4. evaluate the use of GeoWeb 2.0 for environmental sustainability.

This chapter has introduced the two key developments, GeoWeb 2.0 and environmental sustainability efforts, whose confluence has provided the impetus for this research. Their nature has also strongly influenced the design of this research and thesis. In response to the interconnectedness and complexity of environmental sustainability concerns, I have adopted a holistic approach. To then manage scope, rather than single out one theme or aspect, I start in my local context and 2011. The pace and unevenness of change within GeoWeb 2.0 means any research can quickly become dated. To address this, I have chosen a methodology in which the research has emerged and evolved in response to what occurred, and structured the thesis following that evolution.

In Chapter 2, the origins and nature of Web 2.0 and Geo Web 2.0 are further explored, together with significant outcomes of relevance for environmental sustainability and information sharing. Most of Section 2.1, examining the concept of openness as a defining feature of Web 2.0 and GeoWeb 2.0, was published in the *International Journal of Geo-Information* (Clark 2014). The chapter then also examines in more detail environmental sustainability efforts, the role of information and the problems involved with its sharing. While Chapter 2 appears as a literature review conducted at commencement of the research, it was conducted throughout and in response to what was encountered, following the Action Research approach. Considering Chapter 2 then as a literature review gives the impression I was in possession of knowledge at a time that I did not have. Literature was reviewed continually, incorporated throughout the thesis and in this way, is also considered as data.

Chapter 3 addresses the methodology and methods used, starting with the factors influencing their choice. Within the Web 2.0 discourse a defining mode of operation is to “engage and co-

create” as opposed to previous modes of “planning and pushing” (Tapscott & Williams 2008). The former stance was adopted, with engagement with research participants to co-create the research from the outset. The methodology and methods were initially chosen as aligning with this approach, as well as based on my understanding of environmental sustainability, and ethical concerns. They then evolved throughout the research in response to what was found and where I was situated. For the sake of simplicity, I have divided this evolution into two distinct, yet interconnected and interrelated stages. In Stage 1, Participant Action Research (PAR) was used to engage with participants online and offline, while in Stage 2 there was less emphasis on others’ participation and more on observation. The research methodology moved from PAR to Action Research, in which participant co-direction lessened and participant observation increased. Overall the approach was qualitative and I describe how aspects of this tradition of research are appropriate. The thesis structure and a narrative writing style were also chosen as best matching the methodology, recursive evolution and emergent design of the research.

The results of Stage 1 are presented in Chapters 4 and 5, and are structured following the six recursive PAR cycles that were conducted. Chapter 4 describes the results of PAR cycles 1-3, engaging participants predominantly online within free GeoWeb 2.0 services (FGW2S) adapted by myself. Chapter 5 describes PAR cycles 4-6, participation in wider contexts and how wider perspectives on GeoWeb 2.0 were developed. Throughout, I reflect upon how the activities and developments informed the research aims and objectives. These reflections included the use of methodology and methods, and how the experiences of the research influenced subsequent directions. This shows how both the research direction and methodology evolved in response to what was encountered.

Chapter 6 reviews and reflects upon Stage 1 regarding the initial aims and objectives, and methodology. This provides the foundation and rationale for Stage 2, engagements with existing initiatives, the results of which are described in Chapters 7 and 8. Chapter 7 focusses on bottom-up initiatives, and Chapter 8 describes interactions with two top-down initiatives. These interactions provided evidence on how collectives and institutions view and use GeoWeb 2.0 capabilities for environmental information sharing.

Chapter 9 provides a further discussion and synthesis of the research. It revisits the idea of openness as a defining feature of Web 2.0 and GeoWeb 2.0, and contains the remainder of the paper published in the *International Journal of Geo-Information* (Clark 2014), constituting part of the contribution of this research beyond the local contexts to more general and public

knowledge. The splitting of this paper reflects the difficulty of representing the recursive evolution and emergent design of the research in the form of a linear thesis. My findings relating to the research aims and objectives are presented, followed by final comments on methodology. The overall conclusions are summarised in Chapter 10 together with recommendations for further research.

It has been extremely difficult to capture the importance of time and place, and the recursive process of this research in the form of a linear thesis. For reasons of understanding, visibility and discoverability certain published literature was not accessed until part way through. For example, it was through recognition of the convergence of GIS and Social media that I discovered Macnamara's (2010) work. Others, such as Sui, Elwood and Goodchild's (2012) and Anderson's (2012) were published during the research. These understandings contribute to how the context of this research influenced its conduct and what was discovered. For example, some of the descriptions of GeoWeb 2.0 in Chapter 2 were my understanding part way through, not at the start of the research. During the write up I have had the benefit of hindsight and hence sometimes cite literature and experiences from later that clarify or reinforce observations.

Mostly, however, I have included relevant literature where it fits in time, trying to resist "the lure of hindsight" (Kahneman 2011, p.14). For this reason, literature suggested by my examiners that appeared towards the end of the first submission of the thesis (October 2015) is included in an addendum. The thesis documents the situation at a specific time and place, and what is considered the "current state of the art" and "relevant literature" has been influenced by the time taken for examination of over one and half years. That is why I have started Chapter 1 with "in 2011" and have added times to Chapter headings.

Chapter 2 Web 2.0, GeoWeb 2.0 and environmental sustainability

This chapter describes a view of the research subject matter, Web 2.0 and GeoWeb 2.0 (online maps), and environmental sustainability from a Tasmania perspective in 2011. It begins with Web 2.0 and GeoWeb 2.0, focussing on the aspects of openness, interactivity and participation. Next, a description of the nature and scope of the environmental sustainability problem, environmental management and information collection efforts, illustrates the problems for environmental information sharing. The chapter concludes by outlining potential risks and ethical concerns.

2.1 Web 2.0 and GeoWeb 2.0

The popularisation of the term Web 2.0 and its early characterisation as now predominantly understood, is attributed to O'Reilly (2005; 2007). Acknowledging contentions regarding O'Reilly's precedence (Macnamara 2010) and whether Web 2.0 is a new internet feature (Berners-Lee 2006), it is a term that has gained wide usage, adoption and adaptation. The significance of O'Reilly's (2005) seminal paper is its sustained citation in relevant spatial literature (Batty et al. 2010; Coleman, Georgiadou & Labonte 2009; Connors, Lei & Kelly 2012; De Longueville 2010; Ganapati 2010; Haklay, Singleton & Parker 2008; Ho & Rajabifard 2010; Leszczynski 2011; Thatcher 2013). The influence on perceptions of Web 2.0 and GeoWeb 2.0 has been substantial; the Australian Government has recognised the term and its importance through its Gov 2.0 agenda (AGIMO 2009):

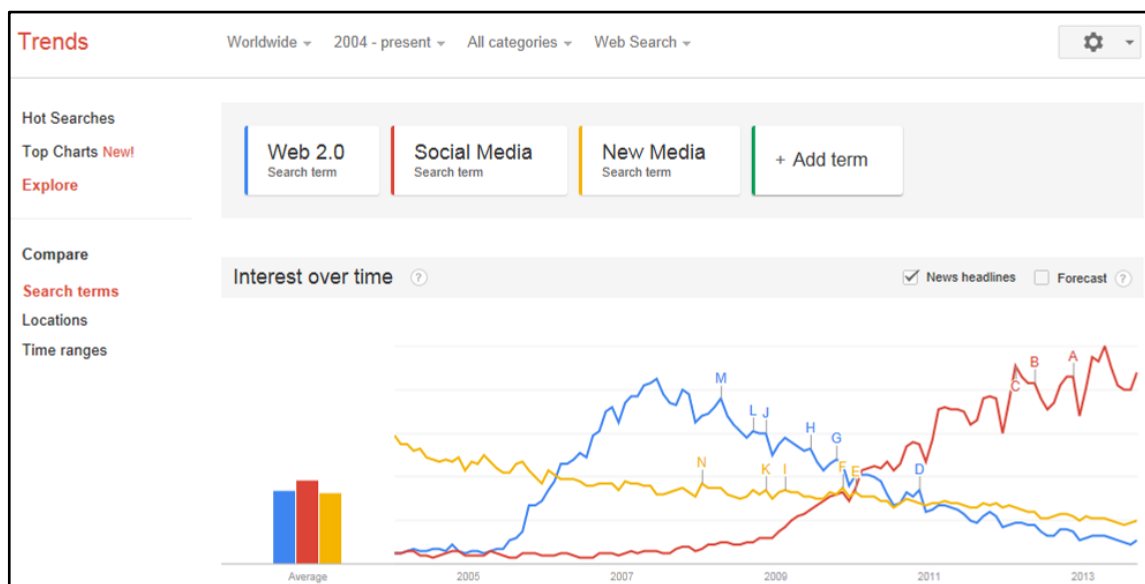
... Government 2.0 is essentially about using technology to realise a more open, transparent and consultative form of government. The term derives from Web 2.0, which refers to technologies that encourage online discussion, sharing and collaboration (AGIMO 2012, p.5).

Its role in Australian disasters has catalysed action under the banner 'Emergency 2.0' (van der Vlugt & Hornery 2010). Other derivatives include Enterprise 2.0, Education 2.0, and Library 2.0. The term refers to new ways of conducting an existing practice, using a Web 2.0 approach. Therefore, it has some essential meaning across a broad range of society.

There are, however, a plethora of descriptions in the literature, as well as a diversity of terminology used to describe the phenomenon. As well as Web 2.0, these include New media

(Flew 2008; Hearn et al. 2009), Emergent media (Macnamara 2010) and Social media (Kaplan & Haenlein 2010). The term Social media is currently in wide use (Figure 2-1). Google searches for Web 2.0 peaked just after 2007, while searches for Social media began rising later than Web 2.0, eventually overtaking it around 2010. The usage of New media originates before Web 2.0, yet has progressively declined. Kaplan and Haenlein (2010) argue that Social media only refers to a particular outcome and subset of Web 2.0, and is often narrowly discussed with reference to the dominant popular platforms. The term Emergent media captures important overall characteristics but is not widely recognised. Hence, I have adopted the term Web 2.0 as the most widely recognised, apt and inclusive.

Figure 2-1: Google Trends searches for the terms Web 2.0 (blue), Social media (red) and New media (yellow).



Source: (Google 2013b)

2.1.1 O'Reilly's Web 2.0

O'Reilly's (2005) original characterisation of Web 2.0 was concerned with the design patterns and business models for the next generation of software. He visualised these "as a set of principles and practices" and discussed them under seven main headings. Noticeably this list did not explicitly include openness and interactivity, while technological factors such as the Web, data, software, programming and devices are included. References to "open" are mainly within the discussion on the importance of open source software and standards, and the related

practices and principles of development. There is even a direct challenge to openness with the importance of “control over unique hard to recreate data sources”. For O’Reilly, the importance of interactivity is acknowledged in the context of providing a rich user experience and allowing users explicit (what they create) and implicit (what they do) contributions to add value. Interactivity is framed as providing a commercial advantage by improving customer experience, enlisting them as co-developers and harnessing collective intelligence.

O’Reilly (2005; 2007) described participation as more important than just publishing. The increased participation in Web 2.0 is largely attributed to the lowering of barriers with increasingly easy-to-use technology requiring little or no specialist software or programming ability (Anderson 2007, 2012; Haklay, Singleton & Parker 2008). Anderson (2007) described participation enabling (web) architectures as crucial to facilitating two way interaction between people in peer to peer (P2P) connections; and resulting in the blurring of boundaries between what were previously separate roles of producers and consumers of information, reflected in the coining of the terms “prosumers” and “produsers” (*sic*) (Bruns 2006).

This increased interactivity of Web 2.0 raised the potential for those with internet access and a certain level of literacy, to create information and other content generally known as user generated content (UGC) (Bruns 2006; Wunsch-Vincent & Vickery 2007). UGC can then be distributed globally and instantaneously, largely without being controlled or mediated. Others can annotate this UGC with tags, ratings, comments or reviews, helping to organise and curate it (De Longueville 2010; Liu 2010). They can also reuse or adapt such information and resources for other purposes. Moreover, such people can find each other and connect in order to collaborate and co-create. Howe (2006; 2008) coined the term crowdsourcing to describe how this allows value to be created by ‘the crowd’, often acting autonomously to self-organise from the bottom up, without top down control or direction. Brabham (2009) proposed crowdsourcing as a means of enabling citizen participation in public planning projects. The idea of mass collaboration is a similar concept to crowdsourcing (Tapscott & Williams 2008) and is ‘based on the principles of openness, peer production, sharing and acting globally’ (Tapscott and Williams 2006 in Haklay, Singleton & Parker 2008, p.2034).

Such ideas build on those of “the wisdom of the crowds” (Surowiecki 2004) and “collective intelligence” (Lévy & Bonomo 1999). Perhaps the most well-known examples of such value creation are the development of Wikipedia (2014b) and the open source software Linux (2014). Shirky (2005) identifies the generation of folksonomies – user generated classifications – as an

important outcome of the Web 2.0 process of “tagging” that harnesses collective intelligence. The geospatial platform Wikimapia (2011) employs user tagging to create a folksonomy-style layer classification. Increased interactivity, UGC and crowdsourcing support claims of Web 2.0 “opening up” or democratising the production and consumption of information (AGIMO 2009; Kaplan & Haenlein 2010).

2.1.2 GeoWeb 2.0 = GeoWeb + Web 2.0

While Web 2.0 began to appear around 2000, GeoWeb 2.0 emerged later (around 2005) due to the need for greater technological capabilities for spatial information (Haklay, Singleton & Parker 2008). Scharl and Tochtermann (2007) describe the emergence of early technological components of GeoWeb 2.0, such as Geobrowsers, and their relationship to other Web 2.0 developments. Epicentres of emergence were large global IT companies and public sector organisations based in North America and Europe, with its most visible component GeoWeb 2.0 platforms (De Longueville 2010; Ganapati 2010). In North America this was epitomised in the private sector by the advent of Google Maps and Earth (Butler 2006; Miller 2006) and in the public sector by the US Government’s Geospatial One-Stop-shop (De Longueville 2010). In the UK, early GeoWeb 2.0 pioneers were OpenStreetMap and the UK’s Ordnance Survey (Haklay, Singleton & Parker 2008), the European Union created the INSPIRE initiative and, at a global level, the Group on Earth Observation implemented the Global Earth Observation System of Systems (De Longueville 2010).

As for Web 2.0, there are many names for emerging spatial technologies previously described as GIS and which intersect with the internet and Web 2.0. They include GeoWeb (Haklay, Singleton & Parker 2008; Leszczynski 2011), Geospatial Web (Elwood 2010; Turner et al. 2008) and Geospatial Web 2.0 (De Longueville 2010; Ganapati 2010; Sieber 2012), and in a special issue of the journal *Geo-Information*, GeoWeb 2.0 (MDPI 2014). The name GeoWeb 2.0 is adopted herein as most succinct and apt, acknowledging the significance of the intersection of spatial capabilities with the interactivity of the wider Web 2.0. Early authors describing aspects of GeoWeb 2.0 situate its origins partly within Web 2.0 (Cartwright 2009a; Haklay, Singleton & Parker 2008; Sui 2008), and literature describing related concepts and practices repeat reference to Web 2.0 origins (Batty et al. 2010; Goodchild 2007a; Leszczynski 2011; Sui, Elwood & Goodchild 2012).

Technological aspects of GeoWeb 2.0 include online interactive GIS, spatially enabled mobile computers, smart phones and other sensors such as cameras (Haklay, Singleton & Parker 2008). It is increasingly difficult, however, to draw clear boundaries between these and other Web 2.0 technologies including aspects such as Social media as linking, embedding and other means of integration develop (Sui & Goodchild 2011). Figure 2-2 shows my concept of how free online applications, including geospatial, can be integrated into an ‘Open GeoWeb 2.0’. This is just one possible version of GeoWeb 2.0, that can also include institutional applications and platforms, such as those mentioned throughout the thesis.

Figure 2-2: The “Open GeoWeb 2.0”



(Source: created by author from available imagery)

Soon after O'Reilly's initial characterisation of Web 2.0, several key papers identify the significance of the intersection of Web 2.0 with developing online geospatial capabilities. Miller (2006) and Butler (2006) discuss the significance of online virtual globes such as Google Maps and Earth, and NASA's World Wind. Miller ponders whether Google has achieved the opening up of GIS to public participation he claims was only theorised under the banner of GIS/2 (see Sieber 2004). Butler also describes how such platforms opened GIS to popular use, the importance of open source software in World Wind, the role of the Open Geospatial Consortium (OGC) and early use of such platforms by the scientific community. He uses an

example of research into walrus migration to highlight the features of the archetypal GeoWeb 2.0 platform, Google Earth, attractive to scientific researchers: free, easy to use, a great visualization tool, easy transition from global to local views, allows the integration of user's data, supports collaboration and has a global reach. Another significant capability of GeoWeb 2.0 platforms is allowing the creation of “mashups”, the generation of user created maps through the integration of other resources on top of the platform (Batty et al. 2010; Cartwright 2011; Miller 2006). An important enabler of mashups are Application Programming Interfaces (APIs) (Ganapati 2010).

Eisnor (2006) and Turner (2006) use the term “Neogeography” to imply that geography has been de-professionalised. Turner defines Neogeography as “about people using and creating their own maps, on their own terms ... about sharing location information ... helping shape context and conveying understanding through knowledge of place” (p. 3). The concept of Neogeography becomes the focus of considerable research interest (Connors, Lei & Kelly 2012; Foth et al. 2009; Goodchild 2009; Haklay, Singleton & Parker 2008; Liu & Palen 2010). A similar concept is described with the term Maps 2.0 (Crampton 2008) and later by Neocartography (Cartwright 2012). Neogeography, Neocartography and Maps 2.0 describe practices similar to crowdsourcing, but more specifically within a geospatial context.

Goodchild (2007a) described the concept of citizens as sensors, crowdsourcing directed toward collecting (sensing) information, or UGC, regarding the environment. Crowdsourced information that explicitly includes its geographic location is described as volunteered geographic information (VGI) (Craglia 2007; Goodchild 2007a; Kuhn 2007), a special case of the wider phenomenon of UGC. Neogeography, citizens as sensors and the practice of VGI have been enabled by developments in spatial technologies that place the ability to collect and geo-locate information into the hands of ordinary citizens. Personal navigation devices such as smart phones that utilise GPS or WiFi to geo-reference and other location based services (LBS), are foundational (Rabaul 2011). Online interactive GIS allow places to be located by their relationship to freely available online maps that are spatially referenced, or by adding place names from which the location can be geo-coded, and provide the ability to create spatial representations (maps) into the hands of non-professional people and more organisations.

The practices of Neogeography, citizens as sensors and VGI are heralded as the democratisation of GIS (Goodchild 2007a; Warf & Sui 2010) and in the geospatial arena, a well-known outcome is OpenStreetMap (OpenStreetMap contributors 2011). The idea of value

being created by “the crowd”, often acting autonomously to self-organise from the bottom up without top down control or direction, is reiterated for spatial information (Sui, Elwood & Goodchild 2012; Warf & Sui 2010). Note that while Goodchild (2007a, 2007b) situates the origins of VGI firmly with Web 2.0, he does not cite O’Reilly’s characterisation or define Web 2.0, other than to refer to the “interactivity of Web 2.0 services” and to describe examples. This concept of VGI later catalyses much research, a sense of which is provided by Sui et al.’s (2012) description of the level of academic interest in the topic of volunteered geographic information in North America, with five specialist meetings and workshops, three special journal issues and specialised research teams.

2.1.3 Implied and explicit openness

It is in these discussions of the increasing usability and use of Web 2.0 and geospatial technologies by the broader community to create, curate and distribute information, of open software and open standards, that implications of openness as a defining characteristic are identifiable. An explicit reference to the openness of Web 2.0 that is subsequently adopted in the geospatial literature appears in Andersen’s (2007) report on the relevance of Web 2.0 for education. Building on O’Reilly’s work, he refers to what he calls “six big ideas” of Web 2.0:

- 1 individual production and user-generated content
- 2 harnessing the power of the crowd
- 3 data on an epic scale
- 4 architecture of participation
- 5 network effects, power laws and the Long tail and
- 6 open-ness (p.14).

For Andersen (2007) “open-ness is a powerful force in Web 2.0” and “the Web has a strong tradition of working in an open fashion ... with open standards ... open source software ... free data ... (and) a spirit of open innovation” (p. 25). Hence open standards, open source software and free data are the means **and** outcome of working in an open fashion and spirit of open innovation, and are then foundational to Web 2.0. Andersen’s list of characteristics are adopted and repeated in subsequent spatial literature (Batty et al. 2010; Stefanidis, Crooks & Radzikowski 2013), with Stefanidis and Crooks et al. (2013) later adding transparency to openness. Haklay and Singleton et al. (2008, p.2034) however caution that:

the concepts of collaboration, cooperation, sharing and openness should be seen within a context of a capitalist mode of production where the collaboration is done from personal motives and in advancement of personal wealth, and less as an altruistic activity (p. 2034).

This recognition of possible motives for openness other than altruism draws attention to power relations and ethical concerns.

Users of Web 2.0 are enlisted both knowingly and unwittingly as collaborators in the co-creation of information and other resources (Anderson 2012; Tapscott & Williams 2008). A main driver for “openness” in Web 2.0 and GeoWeb 2.0 is that it results in better applications and platforms. Providing applications and platforms that allow people to participate and interact with information, applications and other people, produces important “implicit” feedback to the platform developers on what works. That is, what is used is what works. Allowing those users to also provide feedback via such mechanisms as rating and commenting adds a dimension of explicit feedback. The most openness is where participants are allowed and encouraged to modify and develop the platform. A common example is where the platform source code is made open source. A secondary but no less important outcome of this participation is that it can generate spatial and demographic databases of considerable value. It is a primary contributor to the generation of “big data”.

The characterisation of Web 2.0 and GeoWeb 2.0 as about openness and interactivity can be traced back to its earliest commentators and the related literature. Increased ease of use, interactivity, participation and openness are the basis of claims that Web 2.0 and GeoWeb 2.0 represent the democratisation of information and geo-information (Goodchild 2007a; Kaplan & Haenlein 2010; Warf & Sui 2010). Prominent Australian discourses subsequently emphasise the key characteristic of Web 2.0 as openness and interactivity, and more about culture, ideology, philosophy, attitudes, principles and practices, than about technology (AGIMO 2009; Macnamara 2010). The Australian Defence review into Social media refers to “the philosophy of Social media where openness and transparency often take a higher priority” (George Patterson Y.R. 2011, p.ix).

The claims that it is **more** about culture, ideology, philosophy, attitudes, principles and practices are, however, difficult to sustain; the technologies involved are well outlined initially and elaborated on later by Andersen (2007, 2012), and Haklay et al. (2008) provide the same for the geospatial component. If the technology then became established and stable, its importance may lessen, but this is not the case with constant change. Cultural features and practices are inextricably bound within a technological context; the social and technological are mutually implicated and constitutive (Chrisman 2005; Warren 2011): GeoWeb 2.0 is best described as a socio-technological phenomenon. Kaplan and Haenlein’s (2010, p.61) definition

of Social media as “a group of internet-based applications that build on the ideological and technological foundations of Web 2.0” reflects the importance of both. The spatial literature also shows a concern for interpreting the social implications of these manifestations and the related discourses (Elwood 2008a, 2008b).

The importance of Web 2.0 and GeoWeb 2.0 must be cognisant of both its technological and social aspects. Within this thesis I conceptualise GeoWeb 2.0 as a phenomenon that encompasses a collection of technologies, practices, structures or arrangements, and actors operating through institutions, within collectives and as individuals.

With hindsight, the description of Web 2.0 and GeoWeb 2.0 and as presented above is dated and focusses on the early predominantly positive perspectives. This was, however, what was most apparent at the time and repeated by influential Australians and programs. I have retained this perspective to show the influence of memes, ontologies, and conceptualisations and I acknowledge this influence in 3.1. In Australia, Citizen science and many other initiatives were proceeding based on this enthusiasm. As the research progressed I discovered the difficulties in aiming for participation with GeoWeb 2.0, and the strong potential for co-optation and misdirection. Concurrently I discover the Critical GIS literature that increasingly explores the wider implications of GeoWeb 2.0, and apply perspectives from this to my analysis of the initiatives explored in Stage 2.

2.2 Environmental sustainability

If practices supported by Web 2.0 and GeoWeb 2.0, such as user generated content, crowdsourcing and mass collaboration, have led to valuable outcomes, then this should apply equally to environmental sustainability efforts. Interactivity that allows the creation and sharing of UGC could be mobilised for environmental information and management for sustainability. The crowdsourcing of information for environmental sustainability, or as Flannery (2011, p.256) terms “crowdsourced environmental governance”, is an attractive idea, where people use GeoWeb 2.0 to join together in networks of peers, to mass collaborate on addressing environmental management issues. A consideration of the nature and scope of the environmental sustainability problem reveals the issues involved.

There is no generally accepted definition of environmental sustainability. Rather, there are “hundreds of definitions ... (it is) an elastic, slippery and porous aspiration, an idea whose

meanings are multiple and contextual” (Davison 2008, p.150). Environmental sustainability is a complex abstract concept, incorporating knowledge about the state of the environment, perceptions of an impending environmental crisis, and aspirations for that state. The current environmental crisis underlying sustainability concerns is often characterised by a number of different, but overlapping and interacting components or themes including anthropogenic climate change (IPCC 2014); loss of biodiversity and ecosystem services such as clean air, water, soil productivity, pollination; overuse of natural resources – land, fisheries, forests, and fossil fuels; and contamination and pollution (ANAO 2007; SOE 2011).

There are, however, many ways the environment can be characterised. For example, Brown and Kyttä (2014) offer a composite of environmental attributes that, as well as physical components such as those listed above, include aesthetic, recreational, cultural, economic, intrinsic and spiritual values. While these can all be argued as consisting ecosystem services, the environment and related issues are still conceptualised in many ways. It is important to recognise the existence of multiple interpretations, to try to make transparent the context of these, and to support a continued dialogue about their meaning (Davis Jr, Fonseca & Camara 2011; Hage, Leroy & Petersen 2010). An inclusive approach to sustainability recognises this pluralism.

2.2.1 Interconnections, dynamism and complexity

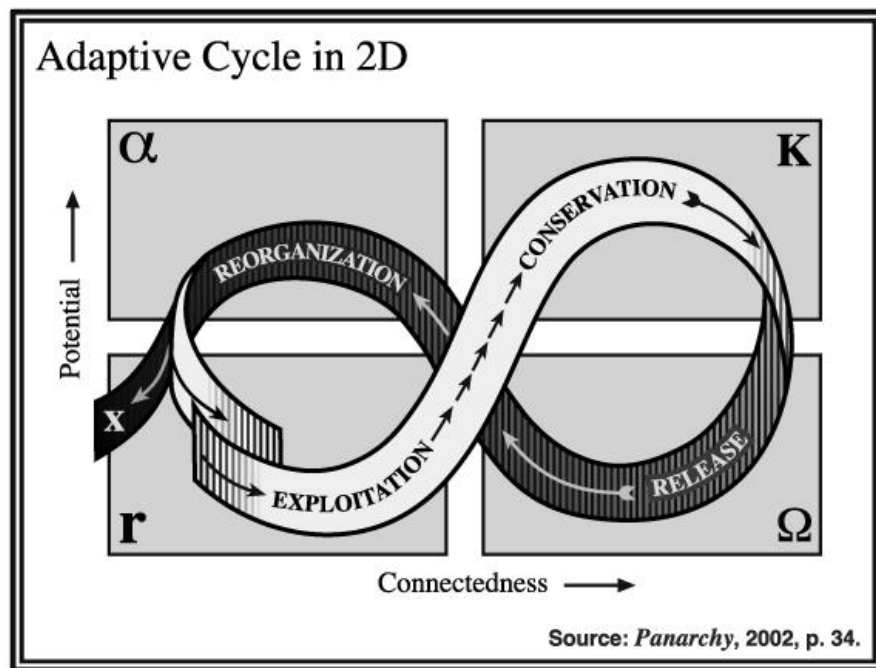
Considering components of the environment in isolation or as differing in importance is problematical as they overlap and interconnect in complex ways. Overuse of natural resources, such as forests and fisheries, leads to loss of biodiversity that in turn reduces ecosystem services of clean air and water. Changes in each component affect other interconnected components that then change and affect others, providing feedback that induces further change. These interconnections and feedback loops are not fully understood. For example, the atmosphere, terrestrial and marine environments, and biological systems are interconnected in complex ways that can amplify or dampen anthropogenic climate change (Ha-Duong et al. 2007; Lovelock 2014). The entwining of environmental concerns with social and economic issues means environmental sustainability cannot be considered separately from other sustainability concerns (Berkes, Folke & Colding 2000) and the importance of time and place cannot be ignored (Hage, Leroy & Petersen 2010; Phillips 2001).

These interconnections and dynamism are captured by complexity and systems thinking, a recurrent theme in environmental sustainability and management (Gunderson, Holling & Light 1995; Harris 2007), with the environment characterised as a complex adaptive system, of which humans are an integral part (Harris 2007), and as a socio-ecological system (Berkes, Folke & Colding 2000). Complex adaptive systems (CAS) consist of interacting, loosely coupled (networked) agents that self-organise to adapt to the current context. This self-organisation and interaction creates emergent properties that provide new contexts, which then drive further adaptation, so the CAS develop and evolve in a recursive manner. Gunderson and Holling (2002) depict this as an adaptive cycle (Figure 2-3) in which evolution occurs in CAS in cycles of four phases: exploitation, conservation, release or creative destruction (disruption) and then re-organisation.

Emergent complexity is not planned beforehand or designed in a top down process. It evolves from the many simple interactions of constituent parts or agents as they adapt and evolve to survive in the current context, in a more bottom up process. This is captured by Dawkins' (1986) description of the process of evolution with the analogy of the Blind Watchmaker. As the internet and related ICT are an outcome of human society (BOM 2013a; Johnson 2001), complexity theory also provides a way of exploring both the internet and the environment. Grus, Crompvoets and Bregt (2010) analysed three national spatial data infrastructures (SDIs) and identified features and behaviours of CAS, arguing that it is important to consider the complex and adaptive nature of SDIs rather than functioning as linear and predictable systems. The relevance for this research has been to require a methodology able to match this dynamism, being prepared for such systems to evolve and the potential for emergent, unexpected developments.

Certain concepts and terminology resonate across characterisations of ICT, the internet and Web 2.0 as a CAS: loosely coupled, modular, networked, self-organising, bottom-up, emerging and evolving. Johnson (2001) described the role and influence of complexity theory and thinking in computer software development, and the role of feedback between the agents as crucial in moving systems from being complex to complex adaptive systems. The interactivity of Web 2.0 allows much more such feedback to occur.

Figure 2-3: The Adaptive Cycle



(Source: Gunderson & Holling 2002, p.34)

There is, however, an important difference between positive and negative feedback, with the former amplifying signals and leading to potential chaos and the latter leading to homeostasis. In “Overconnected”, Davidow (2011) postulated that positive feedback between financial systems linked by the internet contributed to and amplified the 2008 world financial crash. Flood (2010) drew parallels between the systemic, socio-ecological and complexity theory, and used socio-ecological thinking to describe the effects of feedback:

A situation (system and environment) can become particularly volatile when unintended consequences of individual actions build up, become linked in unexpected ways and change the character of the environment itself (p.136).

Seemingly prescient of the disruption of Web 2.0 and climate change, “this is likely to occur in politicised, pluralistic and fragmented circumstances” (p.136). Flood goes on to say the socio-ecological perspective suggests that:

in turbulent conditions that prevail today ... collaborative arrangements, in which resources can be pooled among dissimilar kinds of organisations sharing an environment, may quell disturbance”.

This theory suggests a role for the openness in Web 2.0 that supports collaboration and sharing to counter chaos arising from too much disruption and unintended emergent outcomes. Complexity theory is considered herein to provide a useful heuristic for exploring concepts and processes across the research subject matter.

2.2.2 Multiple scales, urgency, contention and conflict

Environmental processes and issues exist at multiple scales, from the micro, through meso, to the macro – from the local, to regional and global (Davis Jr, Fonseca & Camara 2011; Gunderson, Holling & Light 1995; Harris 2007). Harris (2007, p.19) identified “the rising awareness of the significance of small-scale, individual actions undertaken by agents (individuals, communities, institutions) acting on largely local information (context). Gunderson, Holling and Light (1995) noted that failure in the management of ecosystems often arose from a single scale of focus, often the short term and the local. Consideration of the local context and small scale interactions is important, but cannot be the only focus of assessment. The Millennium Ecosystems Assessment (WRI 2003) emphasised consideration of issues at the appropriate scale, and often at multiple scales. In my professional experience, conditions on the ground have often not correlated with information about those conditions, due to both inaccuracies and generalisation. Conversely, on-ground actions were often made pointless by processes at a larger scale, such as a local conservation project that was subsequently destroyed by developments driven at a regional scale. In both these cases there was no correlation between information and the actions it informed at the local and broader scales. The necessary field of concern is very wide yet also needs to be very specific. It extends outwards to encompass various subject matter, sectors, times and places and inwards to scrutinise the local and particular.

The environmental crisis has led many to call and strive for a more sustainable life, one in which humanity’s present success comes not at the expense of other life or our future selves. Emerging first in the latter half of the last century (Australia 1992; WCED 1987), in the opening decades of this century this call has heightened in urgency to an immediate imperative (Harris 2007; MEA 2005). Yet the position that the environment is in crisis is not universally held. Some dispute the seriousness of our impacts (Lomborg 2001, 2007), or that impacts such as anthropogenic climate change are happening (Leviston & Walker 2012; Plimer 2009). Points of view range along a spectrum from complete rejection of any environmental damage, to those

who insist that humanity's actions (Trainer 2010), and size (Adams & Jeanreud 2008) must change substantially. These contentions cause debates and conflicts, often heated, divisive and paralysing, and often conducted in the public and political arena. The conflict arises for many reasons: different interpretations of what is really happening, different ideological viewpoints about its importance, and differences influenced by who stands to gain or lose from sustainability efforts (Davis Jr, Fonseca & Camara 2011; Davison 2001). It is possible that without major progress in sustainability, competing interests and insecurity will lead to future conflicts (Barnett 2003; Barnett & Adger 2007; Nordås & Gleditsch 2015).

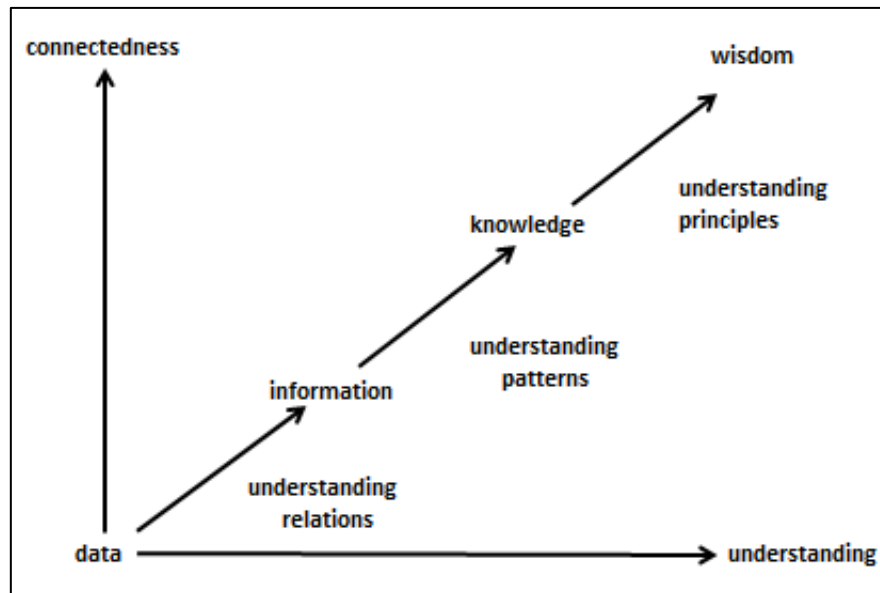
2.3 Environmental management and information

Concerns about humanity's environmental impacts have catalysed efforts to plan and manage human activities to achieve sustainability. Specialized organisations and professions across governments, commercial and not-for-profit sectors are all involved, and act with authority and legitimacy (Australia 2011b; Centre for Australian Ethical Research 2003; Macintosh & Wilkinson 2006). These management activities require the creation, representation and communication of information about the state of our environment, the meaning of this state, what responses should be undertaken, are possible and should be implemented (Australia 1994). For the sake of simplicity, the term "information" is used herein to include all those things humans contain in their minds and attempt to communicate through various types of representation. Ackoff (1989) categorised these as including data, knowledge, wisdom and information, as depicted in Figure 2-4. Although Mansvelt and Berg (2010) emphasize the importance of language for humans, this research includes any representation through which humans attempt to communicate and can be expressed digitally.

Information is then foundational for efforts to manage the environment for sustainability. The nature of the environmental crisis, sustainability quest and management efforts, means the relevant information is broad, diverse, changing and nuanced (NRC 2010). This information ideally includes the complete range of relevant subject matter, covers all humanity's activities, values and concerns. Optimally it should include scientific and social perspectives, qualitative and quantitative measures, and be at a variety of scales of time and place. Regardless, information will always contain some uncertainty and will be of varying quality (Couclelis 2002; Pollack 2005). Because of this and the different values held by people, it will be contentious and contested; some information will be urgently needed, and some will relate to

high risks (APSC 2007). As all environmental issues occur somewhere, “where” in all its possible manifestations – location, time, and society – is paramount for environmental information (Janelle & Goodchild 2011; Kearns, Kelly & Tuxen 2003; NRC 2010).

Figure 2-4: Relationships between data, information, knowledge and wisdom



(Source: adapted from Bellinger, Castro & Mills 2004)

There are many efforts to gather and provide environmental information. Governments (Australia 2011c), businesses (Centre for Australian Ethical Research 2003), academic institutions, other non-government and community organisations (Foran, Lenzen & Dey 2005) monitor the environment and analyse and report this information across a multiplicity of environmental subject matter areas, at a variety of spatial and temporal scales. Doubts remain about the efficacy of this information for resolving debates or designing and implementing a more sustainable environmental future (ANAO 2003; DEH 2002; Macintosh & Wilkinson 2006). State of the Environment (SOE) reporting initiatives are arguably the most comprehensive attempt to organise and deliver environmental information. In a review of sustainability reporting McIntosh and Wilkinson (2006) identified a comprehensive list of problems and issues. Many of these were reiterated at the local Tasmanian level (TPC 2012; Waight 2010), but also included were practical issues not highlighted at a strategic level, such as access to data, data incompatibility and resourcing. A broad range of issues with SOE reporting were expressed in these sources, from which the following are particularly relevant to GeoWeb 2.0 developments:

- what aspects of sustainability should be reported on – there are different perceptions of sustainability and hence what indicators are important
- access to datasets and the mutual incompatibility of these datasets
- which audiences are important and how to reach them
- uncertainty in data arising from a variety of issues
- how to account for uncertainty
- communicating this uncertainty
- bias, whether intentional or accidental
- how to compare sustainability reports across scope and time
- how to account for issues that cross the boundaries of sustainability reports
- inefficiencies arising from the overlaps in sustainability reports
- resourcing the production of SOE reports and
- the timeliness of reports that take 5 years to produce (Macintosh & Wilkinson 2006; TPC 2012; Waight 2010).

Further, reporting initiatives such as these are not the only sources of information needed to support environmental management initiatives aimed at sustainability. Many organisations and individuals regularly produce relevant environmental information that remains inaccessible to the wider community (Australia 2005, 2011b; Centre for Australian Ethical Research 2003).

The historical context of SOE and other environmental reporting is significant. Originating before 2000, SOE methodologies had developed largely before and independently from the information sharing capabilities provided by GeoWeb 2.0. These capabilities have changed the transaction costs of sharing information (Shirky 2008, 2010), and have provided the opportunity for systems of information organisation additional to categorical, such as networked (Lau 2008; Shirky 2005) and spatially indexed. In Tasmania, there have been limited initiatives to utilise web based reporting to overcome issues arising from focusing on text based report formats, mostly transferring these to digital formats and content management systems (Waight 2010).

Elsewhere, Belbin and Gibson et al. (2003) described a web based database for SOE reporting in the Antarctic that demonstrated many of the benefits provided by Web 2.0. Online interactivity allowed access by custodians, managers and the public to enter data or view reports in real time without the delays involved in publication, such that reported information is up to date. Searching and analysis is also far easier in digital formats supplemented by web tools and services. Belbin (2014) stated that, despite this example, similar initiatives in other jurisdictions had not eventuated. The Antarctic initiative still, however, employed a mostly top down development methodology, using scientific indicators selected by experts and with data entry through a template to ensure standardization. The context of the Antarctic initiative is

relatively homogenous both environmentally and socially, there exists a legal mandate for reporting, and the collection of data is by sensor or custodians with defined resourcing support. There are, therefore, strong factors motivating agreement, collaboration and participation. Whether it is scalable or generalizable beyond Antarctica to contexts that are more heterogeneous, without legal mandates and defined resourcing is unknown and untested.

2.3.1 Information is never free

The costs involved in information production and consumption are also significant, for information is never free, and can never be so (Faulkner 2011; Fitzgerald & Hooper 2009). Creation, storage, quality assessment and curation, publishing, and distribution requires resources that include time, expertise, capture, production equipment and other technology, and a medium for representation and storage. The resources required often increase with the quantity, quality, diversity, complexity, degree of distribution of information and difficulty in gaining an audience. Shirky (2008, 2010) calls the resources required for the production and consumption of information “transaction costs”. Such costs motivate information producers to charge fees for information use, for example, Craglia et al. (2010) estimated the additional costs of information in preparing environmental impact assessments.

The internet and Web 2.0 reduce many of these transaction costs because of the difference in the medium of information representation being digital or “soft”, compared to previous print or “hard copy” (Anderson 2006; Gruen 2012). The “physicality” of the medium affects the ease of information creation and capture, subsequent storage, organisation, discovery, distribution, adaptation and reuse (Shirky 2008, 2010). Hard copy media are costlier to produce, store, organise, search, distribute, adapt and reuse than digital, electronic media. Storage in physical forms such as books and journals requires certain amounts of physical space, and a means of organisation such that humans can discover them, hence the existence of libraries and cataloguing (Lau 2008; Shirky 2005). Geography and time impose further transaction costs on physical forms, and hence greater restrictions on discovery and access. A greater distance between information producer and consumer imposes higher transaction costs. Hard copy forms are not machine readable such that any synthesis must be done by human intelligence. The transaction costs involved in producing and consuming information are vastly less (so far) for digital electronic forms compared to hard copy. These differences support arguments that

the benefits of providing public sector information cost free outweigh the disadvantages (Houghton 2011) and underpin movements for open information (Fitzgerald & Hooper 2009).

There are other costs relating to the production and consumption of information. There is an opportunity cost for information not available for consumption (Houghton 2011), such as can be felt most acutely in disasters (Noble 2011). Producers may also incur the cost of not achieving objectives due to a lack of awareness or uptake by potential supporters or collaborators. A similar cost involves localised opportunity costs from uneven access, or information asymmetry, and where others gain from “inside knowledge” (Gruen 2012). There are costs that arise from information that is of low quality and accuracy resulting in sub-optimal decision making and actions (Rajabifard & Coleman 2012). This possibility inhibits many information producers from sharing where they are responsible for quality and accuracy and hence any resulting liability (Cho 2005; Sui 2011). Costs also arise from information that is intentionally misleading or is used against the producer or a third party (protest), raising issues with the disclosure of private and security information (George Patterson Y.R. 2011). Many of the above costs are borne locally by consumers or the environment in the form of negative externalities, while others such as the producers may gain an advantage (Gruen 2012).

2.3.2 Requirement for participation, and openness

Our collective impact on sustainability and the role of information creation and sharing leads some to the perspective that widespread participation is fundamental for sustainability (Berkes 2009; Flannery 2011; Gunderson, Holling & Light 1995; Scholes et al. 2012). Reed (2008, p.2426) concluded that stakeholder participation can “enhance the quality of environmental decisions by considering more comprehensive information inputs” and that this requires the embracing of a diversity of “knowledges”. The Australian Public Service Commission (APSC 2007) identifies the involvement of multiple organisations and stakeholders as critical in addressing complex² problems, such as environmental sustainability. Hage et al. (2010, p.246) posit that such environmental problems require an approach³ incorporating “participants in ... extended peer communities ... all kinds of stakeholders who ... contribute by sharing their local, environmental, sectoral and other kinds of ‘hands on’ knowledge”. The United Nations

² The APSC use the term “wicked”, which means problems that defy reductionist, partial treatments that often result in creating new and unintended problems, referred to as perverse outcomes.

³ Again they use the term “post-normal science” which is beyond the scope of explanation here.

(1992) maintained that broad public participation in decision making is foundational to sustainable development and that:

Individuals, groups and organisations should have access to information relevant to environment and development held by national authorities, including information on products and activities that have or are likely to have a significant impact on the environment, and information on environmental protection measures (United Nations 1992, para. 23.2).

If, as maintained by Bradbury (2005, p.312) “our world is structured (*sic*) in our micro-interactions”, environmental sustainability is an outcome of humanity’s collective actions, and non-inclusion of some of the community will result in only partial achievement. The effect of non-participation can be substantial if those non-participants possess the power to affect a disruptive world view. Such power may be increasingly available; Australia’s Defence Science and Technology Organisation (2013, p.6) states a key challenge to security as “global access to commercial-off-the-shelf technologies and the rapid progression of cyber capabilities and other disruptive technologies”. Flannery (2011) highlights the seriousness of alienation when the disaffected heavily discount the future, in a world where increasing environmental fragility can mean the possibility of catastrophic and irreversible change.

My professional experience in environmental sustainability issues, environmental management and the use of environmental information has contributed to a perspective that widespread participation is essential. Within this perspective the purposes, various types and levels of participation are many and its value is contested (Reed 2008). From this position, any participatory potential within this technological revolution justifies attention, particularly given that outcomes may be beneficially transformative or negatively disruptive, or both, given the uneven distribution of power dynamics. Claims for the democratisation of information suggest promise that this participation can be sufficiently broad-based to encompass the information sharing requirements of environmental sustainability. The broadness of environmental information requirements, the requirement for integration and synthesis, supporting holistic perspectives, and incorporating wide participation are challenges for which the openness of GeoWeb 2.0 is eminently suited. Environmental sustainability and its attendant information management issues are one of “the challenging problems of our time ... that often demand synergy in methodology, holism in ontology, pluralism/open-mindedness in epistemology, and embracing diversity” (Sui & DeLyser 2011, p.10). Hence, throughout the research I resisted ongoing pressures to narrow the research question, instead maintaining a stance of openness to

the full scope of environmental sustainability definitions and concerns, and to allow participation that could be broadly inclusive.

2.4 Risks and ethical concerns

In Australia, substantial public funds are invested in national infrastructure, such as the National Broadband Network, to capitalise on the perceived efficiencies and productivity opportunities of the internet. Locally in Tasmania, the Spatial Foundations project (Tasmanian 2014) sought to modernise state spatial infrastructure, theLIST, for similar purposes. Other forces, such as the collection of information for commercial applications, retail and advertising through social networking, will hasten the progress of GeoWeb 2.0. Is this justified and well directed, is there a sufficient research basis, should such investments be increased, and who are the potential winners and losers? There exists the imperative to understand the conditions that foster manifestations of GeoWeb 2.0, to explore the opportunities while remaining cognisant of the risks.

Allowing the bypassing of traditional controls and authorities can give voice to those otherwise silenced (Cartwright 2009a), but the outcomes may not be positive. The ability to create UGC and VGI extends to content that is vexatious, libellous, transgresses privacy and intellectual property rights, is otherwise sensitive, or wrong (Sui 2011). Or the outcome could just be a waste of time, with the crowd creating content that is useless, frivolous or erroneous, as pointed out by Keen in his book ‘Cult of the Amateur’ (2008). Janelle and Goodchild (2011) identified the need for rigorous assessments of VGI to determine how it can be “synthesised, verified and integrated into scientific research” (p.31). The undermining of industries such as music, newspapers and retail, facilitated by Web 2.0 as crowdsourced UGC replaces for free what were previously commercial products has far reaching implications for communities. (Macnamara 2010; Morozov 2011; Schmidt & Cohen 2013).

Further, as users unwittingly contribute information during online activity, the inclusion of “where” enabled by GeoWeb 2.0 can introduce further risks to privacy and security. Elwood and Leszczynski (2011) identify representational forms that facilitate identification, such as geotagged images and self-authored texts, and hence argue a need to revisit and reconceptualise privacy. Location enabled devices such as smart phones have been identified as a risk to personal (Rabaul 2011) and national security (George Patterson Y.R. 2011). The possibility of ubiquitous surveillance, where spatially enabled devices and sensors can monitor constantly

the location of everything, including us, portends the end of privacy (Carr 2008; Sui 2011) and potential for geo-slavery (Dobson & Fisher 2003; Obermeyer 2007). Macnamara (2012) described how crowdsourced maps of North Korea stirred international political tensions. Such risks are likely to influence participation and interaction within GeoWeb 2.0.

Issues of who stands to benefit and lose from GeoWeb 2.0 are sharpened by consideration of the inequality of access. Even with equality of access, differences such as ability and available time influence the capacity to gain from GeoWeb 2.0, adding to the digital divide (Sui, Goodchild & Elwood 2012). Further, while all of us who have access may be contributors, no particular individual, organisation or nation is co-ordinating, leading or mandating this development alone (Schmidt & Cohen 2013); it is the cumulative outcome of many efforts. Some individuals, organisations and countries do, however, have a greater role, more power and gain more from its realisation (Sui, Goodchild & Elwood 2012). Livelihoods are at stake, and the physical and social infrastructure this supports, some may win while others lose.

2.5 Summary

This chapter has described the emergence and nature of Web 2.0, and GeoWeb 2.0 as the intersection of Web 2.0 and GeoWeb capabilities. For simplicity, henceforth I will refer to both Web 2.0 and GeoWeb 2.0 with the term GeoWeb 2.0, and this includes both its technological and social manifestations. Interactivity, participation and openness were identified as significant characteristics that have important implications for efforts to share information used for environmental management and sustainability.

Environmental sustainability is a concept with multiple interpretations, hence requiring an inclusive approach, and involving environmental management efforts that in turn require relevant information sharing. Relevant environmental information is almost limitless in scope, and arguments that the success of environmental management efforts requires widespread participation are considered to have validity. Problems with information sharing for State of the Environment reporting efforts were identified, together with a discussion of how GeoWeb 2.0 reduces the transaction costs of information sharing. This addresses part of the first research objective, to identify issues with traditional environmental information sharing.

The interactivity and openness of GeoWeb 2.0 provides significant potential for widespread participation in environmental information sharing and management; to encompass the full

scope of environmental information, as well as the diversity of ways this is conceptualised and perspectives of what environmentally sustainability entails. These potentials need to be considered in the context of the risks arising from GeoWeb 2.0 and attendant ethical concerns, as outlined in the final part of the chapter.

The next chapter now turns to the methodology used within the research to approach the aims and objectives in the context of ethical concerns.

Chapter 3 Methodology 1: Engage and co-create

This chapter describes the overall research methodology. It begins by outlining influences on the choice of methodology, and then describes Action Research (AR) and the version of AR implemented in Stage 1: Participant Action Research (PAR). The worldview of AR and PAR necessitates alternative and expanded criteria for rigour, validity and quality compared to other research traditions, and these are established. The quality of this research is not then as a rigorous application of the scientific method, but as an alternative and complementing perspective. Similarities between PAR's recursive cycles, models of environmental management and complexity are identified. The role of PAR methodology in facilitating participation and its relationship to GIS-mediated participation are described. Issues regarding participation are discussed, including my own participation, use of critical reflexivity and ethical concerns. The last part of this chapter outlines the methods used in Stage 1 to implement PAR online.

3.1 Methodological influences

In response to Anderson, Adey and Bevan's (2010) argument regarding the influence of context on method and the importance of its acknowledgement, this section describes the influence of the context of this research. Factors that influenced the choice of methodology were the perceived mode of working with Web 2.0, the nature of the environmental sustainability problem as described previously, and ethical considerations.

A strong influence was the emergence of Google Earth and Maps as representing a major step change in GIS, and part of the developing internet and wider changes in ICT technologies. The literature about the internet, available in libraries and bookstores, provided the initial lens through which the research was framed. Jeff Jarvis's "What would Google do" (2009) introduced the world of Web 2.0 and Social media. Other available books on the topic of Web 2.0 were: Clay Shirky's "Here Comes Everybody" (2008), "Cognitive Surplus" (Shirky 2010), "Wikinomics" by Tapscott and Williams (2008), "Click" by Bill Tancer (2009), "Crowdsourcing" (Howe 2008) and Chris Anderson's "The Long Tail" (2006). These early references were predominantly positive in terms of the implications of these technological developments and ways of working. They were important influences that formed part of the initial context of the research, referred by Law (2004) as the hinterland, and framed the

direction of the research. Web 2.0, environmental reporting and complexity provided the first terms for searching the literature.

Concerns arose that these early readings were vulnerable to the hype Woolgar (2002) calls “cyberbole”, raising doubts about their academic legitimacy. Many of these sources were, however, also cited by key geospatial academics, (see especially: Batty et al. 2010; Haklay, Singleton & Parker 2008). This establishes their credentials, if not as rigorous sources, then as formative of the emerging Web 2.0 zeitgeist, including in the academic geospatial area of research. The necessary “goodness” of a spatially enabled society is also expressed by Australian academics (Paudyal 2012; Paudyal, McDougall & Apan 2012a; Williamson, Rajabifard & Holland 2010), contributing to a deterministic view of the positive benefits of GeoWeb 2.0 developments.

Tapscott and Williams (2008) argued that the way to gain participation with Web 2.0 was to “engage and co-create”. Outcomes then evolve from the bottom up, through the collaborative and self-organising efforts of participants. Starbird and Palen (2011) identify self-organising behaviour amongst digital volunteers responding to crises and new forms of volunteerism not previously possible. This contrasts to a traditional mode of operation defined by command and control, where developments are “planned” from the top down, and then “pushed” out to users and consumers. This idea of engaging and co-creating is reinforced in the Gov 2.0 report “Engage – getting on with government” (AGIMO 2009). Ideas of self-organisation occurring from the bottom up also resonate with descriptions of how complex adaptive systems evolve and create emergent properties (Allenby & Sarewitz 2011; Gunderson & Holling 2002; Harris 2007; Johnson 2001).

Engaging and co-creating also requires not waiting for perfection, captured in slogans such as “worse is better” and “always beta” (Shirky 2008, p.122). Raymond (1999) characterised this as the difference between ways of working on a cathedral (organised) and in a bazaar (unorganised), where interestingly the apparent chaos of the latter was able to produce the open source software Linux. Referring to IBM’s participation in open source development, Joel Cawley said “keep in mind that there was no strategy ... it was happenstance all along” (Tapscott & Williams 2008, p.312). These approaches were adopted as they aligned with the research aims for immediate participation and appeared appropriate to the Web 2.0 context. Not presenting the research as too professional or exclusive was also important for, as Christians (2005, p.148) warns, researchers “carry the mantle of university authority as they

venture out into the local community to do research”, with the potential to create unequal power relations. As well as not being perfect, the emphasis was for simplicity, being open, and having few rules (O'Reilly 2005; Shirky 2008, 2010; Tapscott & Williams 2008).

Several additional reasons informed engagement with the community from the start of the research. Researching broad-based community environmental information sharing should not be done for, or to the community; it had to be done with the community. This was informed by my own ideological and ethical perspectives, or as referred to within qualitative research, axiology (Dowling 2010), as well as practical reasons of efficacy. Hage et al. (2010) identify that, as part of democracy, stakeholders are entitled to participate in the production of knowledge that regards them. The aims of PAR align with this, working with people to create something of use to them and by taking into account their needs and views (Kemmis & McTaggart 2005; Kindon 2010; Kindon, Pain & Kesby 2007).

Practically, it was thought that the community could assist and provide additional resources for the project. In fact, creating GeoWeb 2.0 platforms that would allow broad community sharing of environmental information was considered a task far too large, complex and dynamic to be undertaken by either the researcher or a limited set of people alone. Hence, community engagement in the research was considered ideologically desirable and practically necessary. The possibility for participation was afforded by Web 2.0 applications that allowed online interactive and collaborative spaces to be created quickly and easily to engage with interested participants.

3.2 Action Research, Participant Action Research

PAR was initially chosen as a research methodology for several reasons. It appeared to correspond with the Web 2.0 mode of engage and co-create; descriptions of community interaction, collaboration and participation via Web 2.0 technologies were similar to the PAR process. PAR could also incorporate broad community participation in actively sharing environmental information for sustainability. Finally, the PAR worldview aligned with many of the perspectives, values and ethical concerns important to the researcher. The worldview of PAR is mostly shared by the wider family of research methodologies termed Action Research (Dick 2006; Greenwood 2015; Reason & Bradbury 2001a). As the research progressed, methodological aspects from this wider family were incorporated.

Reason and Bradbury (2001b) describe Action Research not as a methodology, but a view of the world that acknowledges we are always in relationships involving participation and action; “a family of approaches to inquiry which are participative, grounded in experience and action oriented” (p.xxiv). Action Research is methodologically pluralistic, integrating both qualitative and quantitative approaches (Greenwood 2015; Herr & Anderson 2005). Law advises that “while standard methods are extremely good at what they do, they are badly adapted to the study of the ephemeral, the indefinite and the irregular” (Law 2004, p.4). Web 2.0, GeoWeb 2.0, nor environmental sustainability issues remained concrete, stable or easily defined while I studied them. In response, I used several approaches throughout the research. Choices about which methodologies to use were not made on the basis of their ability to describe objectively what was out there, but more on the changing context and the basis of the right way to proceed – considerations of power and ethics (Dowling 2010).

PAR is a relatively new and emerging qualitative research methodology originating from the combination of Participatory Research and Action Research (Kemmis & McTaggart 2005; Kindon 2010; Kindon, Pain & Kesby 2007). PAR draws on “different traditions in the study of practice and different methods and techniques can provide multiple resources” (Kemmis & McTaggart 2005, p.573). This is part of a broader shift in qualitative research that considers that “methods, their rules, and even methods’ practices not only describe but also help to produce the reality that they understand” (Law 2004, p.5). Kemmis and McTaggart (2005, p. 66-568) list seven key features of PAR: a social process, participatory, practical and collaborative, emancipatory, critical, reflexive and aiming to transform both theory and practice.

An important objective of PAR is to both describe and help change social reality. PAR has been used to address unequal power relations (Kemmis & McTaggart 2005; Kindon 2010; Kindon, Pain & Kesby 2007). Pratt et al. (2007) used PAR with Filipina migrants in Canada to build capacity and community alliances to change working conditions, understand migrant experiences of integration, address racism and feelings of isolation and despair. In Australia, PAR has been used in research assisting communities to address economic decline in the La Trobe valley (Cameron & Gibson 2005) and Shepparton (Gibson, Cameron & Veno 1999). For environmental management, Parkes and Panelli (2001) describe the value of PAR in integrating catchment ecosystems and community health for sustainability. Such use can result in

improvements in living and working conditions for those involved (Bhatt & Tandon 2001; Kindon, Pain & Kesby 2007).

For this research, the use of PAR could address imbalances in community participation in SOE reporting and community sharing of environmental information. Such community empowerment can be supported as PAR challenges the biases and preconceptions of those in power, such as governments and other authoritative institutions, regarding the knowledge of others (Bhatt & Tandon 2001; Sanderson & Kindon 2004). Increasing broad community participation in information sharing can challenge or bypass government and other institutional control. St. Martin and Hall-Arber (2007, p.51) concluded that PAR projects can “effect change by producing alternative ontological and discursive foundations vital for imagining sustainable environmental/economic futures”. Brockington and Sullivan (2003) and Kesby (2000) argue that PAR can bring about change more successfully than “normal” social science research methods.

Acknowledging the connection between power and knowledge, PAR seeks to address traditional imbalances in the power relationships in research by directly involving community members as co-researchers (Hay 2010; Kindon 2010). This involvement requires that community participants are not merely the subjects of the research but actively contributing, collaborating and ultimately assisting in its direction. It reflects the ontological commitment within PAR to the validity of multiple world views and “knowledges” (Elwood 2011; Reason & Bradbury 2001b). In the process of co-constructing knowledge with research participants, what people do, how they interact, what they mean, what they value and their discourses are foundational to its implementation and success (Kemmis & McTaggart 2005).

AR and PAR share some of the ontological perspectives of the wider tradition of qualitative research (Denzin & Lincoln 2005; Hay 2010; Mason 2002) that challenge the claims to privilege of the positivist view of reality and the objectivity claims of the scientific method. They ask fundamental questions about the nature of reality, how it is possible to know reality and if or when knowledge can be objective. This challenge is made explicit with respect to human affairs, “attempting to make sense of, or interpret phenomena in terms of the meanings people bring to them” (Denzin & Lincoln 2005, p.3) by “watching people on their own territory and interacting with them in their own language on their own terms”(Kirk & Miller 1986, p.9). In this social arena, qualitative research asserts the value of its situated approach that recognises

the multifaceted, nuanced, fluid and contextual aspects of reality, and seeks to adequately represent the subjectivity of knowledge about that reality.

Ontological perspectives adopted within this research importantly reject many of the dualisms and dichotomies found in other research traditions, as:

“Generations of anthropological work show not just the prevalence but the cultural work dichotomies do in creating apparent boundaries where none exist and how these dichotomies easily convert into moral hierarchies” (Dick 2015, p.194).

Dick and Greenwood (2015) discuss how Action Research rejects the dichotomies between research and activism, theory and action. Another distinction is often drawn between what is considered in, and not in, the research field. In Action Ethnography, “every experience, conversation and encounter can be treated as ‘material’ or ‘data’ ... in ethnography ‘everything is material’” (Tacchi, Slater & Hearn 2003, p. 10). In the introduction to their handbook on Action Research, Reason and Bradbury (2001a, p.11) quote Marja-Liisa Swantz: “I do not separate my scientific inquiry from my life”. All encounters relevant to the research aim are hence considered to be within the field of research.

The interconnection between facts and values (Pirsig 1991; Putnam 2002) means subjectivity on the basis of the researcher is unavoidable. Action Research then uses researcher reflexivity to systematically and critically examine subjectivity and thereby establish rigour (Dick 1999; Dowling 2010) and this is used throughout my research. Accordingly, rigour, validity and quality are established with different criteria in AR and PAR compared to traditional research traditions (Bradbury & Reason 2001; Herr & Anderson 2005; McTaggart 1998).

3.2.1 Rigour, validity and quality in AR and PAR

Bradbury and Reason (2001), Herr and Anderson (2005), and Kemmis and McTaggart (2005) articulate broader and alternative criteria for evaluating the worth of AR and PAR appropriate to its particular worldview. Bradbury and Reason (2001, pp.450-454) list the following issues as choice points and questions for quality in action research as:

- relational praxis – is the AR explicit in developing a praxis of relational participation?
- reflexive-practical outcomes – is the AR guided by reflective concern for practical outcomes?

- plurality of knowing – is the AR inclusive of a plurality of knowing, ensuring conceptual-theoretical integrity, embracing ways of knowing beyond the intellect, and intentionally choosing appropriate research methods?
- engaging in significant work – is the AR worthy of the term significant?
- emergent enquiry towards enduring consequence – is the AR emerging towards a new and enduring infrastructure?

Herr and Anderson (2005) sought to broaden the bandwidth of validity with the following criteria (p.55):

- dialogic and process validity – the generation of new knowledge
- outcome validity – the achievement of action oriented outcomes
- catalytic validity – the education of both researcher and participants
- democratic validity – results that are relevant to the local setting and
- process validity – a sound and appropriate methodology.

In their description of PAR as communicative action within public spheres, Kemmis and McTaggart (2005) list 10 key features of PAR methods as:

- constituted as actual networks of communication among actual participants
- self-constituted – voluntary and relatively autonomous
- frequently existing due to legitimation deficits
- constituted for communicative action and for public discourse
- aiming to be inclusive
- involving communication in ordinary language
- generative of communicative power ... by the power of mutual understanding and consensus
- not affecting social systems directly, their impact is indirect
- presupposing of communicative freedom and
- associated with social movements.

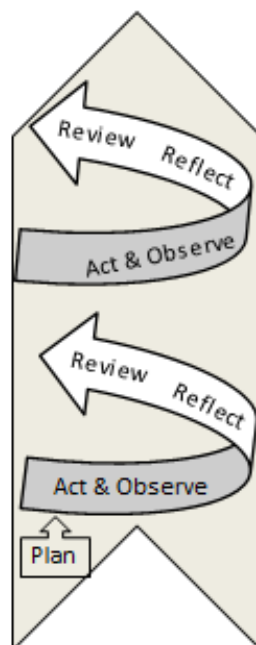
The generation of new knowledge is a research goal common to all traditions. Outcome validity acknowledges that “rigorous AR rather than simply solving a problem forces the researcher to reframe the problem in a more complex way, often leading to a new set of questions or problems” (Herr & Anderson 2005, p.55). Catalytic validity is similar to the concern for the quality of relationships.

These broader criteria for validity and quality, and the features of communicative action within public spheres, are used as a guide and reference points in this research, and inform what constitutes data. The value orientation of the research is as important as the techniques used. Issues of ethics and representation are paramount and the process is as important as the outcome. Measures of success include the extent to which the skills, knowledge and capacities of the participants have been developed and the quality of the information generated. This value orientation is appropriate given ethical concerns arising from the risks of online participation. An important caveat on the achievement of these ideals is the constraints from existing structures and power relations (Bradbury & Reason 2001). Thankfully, as Bradbury and Reason concede, “no one AR project can be perfect in the sense of responding to all the issues we note. Some concerns are simply more pressing in particular contexts” (2001, p.448).

3.2.2 PAR's recursive cycles

Participation, co-direction and both data generation and collection are achieved in PAR through recursive, adaptive cycles of planning, doing and reviewing (Figure 3-1).

Figure 3-1: Participant Action Research process of recursive cycles



Source: adapted from Kemmis and McTaggart (2005)

Action is first planned and then executed, observations made and reflected upon. Based on this experience a reviewed plan of action is developed and acted upon, observed and reflected upon again. This process is repeated in iterative cycles through which the research progresses. The observation and reflection seek to incorporate the experience and views of the participants, to inform subsequent cycles of planning and doing. In this way the research adapts and progresses in response to the ongoing feedback of participants (Dick 1999).

These cycles involve collecting data while simultaneously reviewing the literature, interpreting the data as the literature provides a deepening understanding from other perspectives and theory. Herr and Anderson (2005) describe the relationship between data and the literature as literature in dialogue with data, and for which a dialectic argument and narrative style of writing is appropriate. Dick (2007) saw similarities between how this process builds theory from experience in Action Research, and how Grounded Theory builds theory grounded in data. Grounded Theory is a research methodology that starts with a question or a collection of data, rather than with theory (Bryant & Charmaz 2007). Theory is then derived through a repeated, recursive analysis of the original and additional data. Dick et al. (2009) identify how “many authors draw attention to the dialectic between theory and practice” (p.6) in Action Research. The research process is then not linear but recursive, and the design emerges from this process (Dick 1999) as understanding is developed, questions are reformulated and additional methodologies drawn upon (Dick 2000). This thesis is structured following the evolution of these recursive cycles of data collection, learning, reflecting and theory building.

The cyclical and recursive nature of PAR methodology is also reflected in models of how information is collected and used in environmental management. Two models for this process are Adaptive Environmental Management (AEM) (Figure 3-2), also called Adaptive Resource Management (ARM) (Gunderson, Holling & Light 1995), and Environmental Management Systems (EMS) (ISO 2009). AEM and ARM are processes developed explicitly for dealing with the complexity and uncertainty involved in managing human interaction with natural resources (Gunderson, Holling & Light 1995). They involve recursive cycles of planning, doing, assessing or checking, and reviewing that informs subsequent cycles of action that are also found in the EMS methodology.

These models reflect the dynamism of the underlying subject of study or management, the environment and society, including ICT technology as an emergent property of human society (BOM 2013b; Johnson 2001), and allow ongoing calibration and meshing with this dynamism

through adaptive cycles. PAR provides a way to match and mesh with the dynamism of such complex adaptive systems, and hence a means to engage with them as subject matter (Phelps & Graham 2010; Phelps & Hase 2005). This alignment between models of the research subject matter and the research methodology is appropriate and desirable:

Action research is oriented to some action or cycle of actions that organizational or community members have taken, are taking or wish to take to address a particular problem or situation (Herr & Anderson 2005, p.3).

Figure 3-2: Adaptive Environmental Management process diagram



(Source: CMP 2013)

Due to this dynamism, the efficacy of a traditional scientific methodology is doubtful wherein a hypothesis is proposed and then tested in such a way others can subsequently repeat for verification. Rather, this research is exploratory, as described by Kemmis and McTaggart (2005) and recommended as appropriate for complex problems (APSC 2007). Flood (2010) describes complexity theory as a new form of systemic thinking, and argues that systemic thinking provides “a grounding for Action Research that may broaden action and deepen research” (p.282).

3.2.3 PAR and participatory GIS

As the first year of my PhD program progressed, I found PAR and similar participatory techniques prevalent in the research on, and the use of, GIS to facilitate public participation. In a discussion of the foundations, practices and future directions of participatory approaches in GIS and society research, Elwood (2011) describes a number of studies that use PAR. These “grass roots GIS” research projects aim to empower the community through improving their participation in GIS-mediated decision making. Elwood and colleagues’ (2007) research in the United States using PAR for GIS mediated community empowerment in the Humboldt/West Humboldt Park community GIS project, is described as Participatory GIS (PGIS). McDougall (2009), however, differentiated PGIS approaches as more mediated than the sorts of interactivity and exchanges enabled by Web 2.0.

The discipline of (Public) Participation Geographic Information Systems (PGIS/PPGIS) explicitly seeks to use and study public participation mediated by GIS (Jankowski 2009; Sieber 2006), yet in 2011 the literature made little reference to developments in Web 2.0. Seiber’s (2006) review of PPGIS predates most of the key papers describing the implications of the intersection of geospatial technologies with Web 2.0, such as those on Neogeography by Eisnor (2006) and Turner (2006) and on volunteered geographic information (Goodchild 2007a; Kuhn 2007). Kingston (2011) discusses the use of online GIS for PPGIS and hints at the emerging importance of Web 2.0. His conclusions on the use of online public participation GIS for spatial planning look forward to when “Web 2.0 begins to take hold ...” and “... offers real opportunities to improve decision making and participation ...” (2011, p. 377). Referring to the “frenetic discussion centred on Web 2.0-GIS” in a discussion on participatory approaches to GIS and society research, Elwood (2011, p.394) identifies a remaining “need for systematic empirically grounded research on how and with what impacts such new technologies are actually taken up in activism, collaborative planning and other contexts”.

Early in this research, Australian PPGIS researchers in environmental subject matter were also largely silent on the implications of Web 2.0 (Brown & Weber 2011; Brown, Weber & Zanon 2009; De Freitas 2010). De Freitas’ (2010) work on the use of PPGIS in Australia was of interest for its natural resource management application, and Brown and Weber (2011) used GeoWeb 2.0 capabilities in research into landscape values in National Parks with the Victorian State government, but both referred to few developments in GeoWeb 2.0 and related literature.

Hence, I did not pursue PPGIS until later when searching for literature on Australian developments related to GeoWeb 2.0.

3.3 Participation, reflexivity and ethics

I also decided to participate directly in the research, as part of the community. This was again considered desirable on both ethical and practical grounds. The ethics of asking the community to do something I was not prepared to do myself were unacceptable. Practically, it was considered necessary to provide examples to demonstrate the concepts. Doing so would provide an additional test of the efficacy of the approach and GeoWeb 2.0 applications used. My participation provided particular insights into the issues and opportunities involved, but also raised issues of my position and subjectivity affecting quality and validity claims (Dowling 2010). This raised important questions regarding values and ethics, and how I represented myself and the research to the participants (Mason 2002). The attitude of the researcher strongly defines the degree to which participation in the research is encouraged. Rather than extraction of research data, the primary researcher's role is described as one of facilitation (Kindon 2010), working with and for the research group to achieve co-learning and collaboration (Heron & Reason 2006). A completely hands-off approach, however, may run the risk of allowing the situation to become too chaotic (Kindon 2010). In addition to the nature of each particular research setting, how I presented, was perceived and positioned, as an expert or novice, affected the degree to which I was an insider or an outsider during interactions (Herr & Anderson 2005).

3.3.1 Researcher influence and reflexivity

To be cognisant of the effect of how I was situated and positioned, as insider or outsider, I employed ongoing reflexivity (Hay 2010; Herr & Anderson 2005). Reflexivity is used by the researcher to consciously and explicitly define their own position in relation to the research (Mansvelt & Berg 2010; Winchester & Rofo 2010). Anderson and Adey et al. (2010) argue that this position should include the geographic and social context in which the research methods are employed. This was done initially in the preface of this thesis, in which aspects of my history and perspectives that led to this research are outlined. By practising ongoing reflexivity throughout the research, the researcher makes assessments of how their position, actions and subjectivity influences what is observed (Dowling 2010). Relevant issues for reflexivity included my ontology or worldview, epistemological position and the axiology, or

power relations and accompanying ethical issues, within the research. For example, my worldview was initially a version of positivism, but was challenged and changed by this research. My epistemological view is that many forms of knowledge are valid, and that this is often context dependant, but reflexive experience sharpened an appreciation of the limitations of computer mediation. In terms of power relations, to some participants I was potentially seen as more powerful, as the holder of specialist knowledge, while for others such as professionals and senior managers, I appeared as naïve and unskilled and positioned as a subordinate.

Cognisant of my influence as principle researcher, I tried to communicate the possible benefits from participation in the research in as neutral a way as possible. It was crucial that I was not leading in terms of what direction and information was important. The approach was to present the capability to people and allow them to decide how to act without undue persuasion. A central message was that I expected the research would lead to insights and improvements in the reporting of information supporting sustainable environmental management, as well as the use of GeoWeb 2.0 for this purpose. Reflexivity contributed to an awareness of the possibility of misrepresentation such as overemphasising the positives, and of leading rather than observing. When participants did not respond, this was also then seen as significant. Waitt (2010) supports paying attention to silences, for, as Davies and Dwyer (2007, p.2) suggest, “not only is silence a constructive political intervention, it may actually turn out to be at the centre of politics and demands to be taken seriously”. Reflexivity also extended to more mundane levels, such as the choice of language, font, colour and layout used in writing.

Reflexivity was operationalised by keeping an research journal (Phelps 2005) in which I recorded what I did, observations and thoughts, records of interactions and conversations, web reviews and documents read. The journal amounted to over seven hundred A4 pages of handwriting (**Error! Reference source not found.**). It also provided the medium for ongoing reflexivity considering how my position may have affected what and how I recorded data. Other records that complemented the journal included emails, researcher reports and meeting notes. Emails as well as constituting point data often expanded into extended conversations. For analysis of this qualitative data, thematic analysis was used through a process of indexing and coding my journal notes and other records (Cope 2010) using an iterative inductive/deductive approach (Fereday & Muir-Cochrane 2006). This analysis was then used as the basis for interpreting what influenced people’s participation. The journal then constitutes a major source

of data, as well as metadata about the context of that data collection, that informs an unfolding analysis.

3.3.2 Recruitment of participants

Other people were invited to participate and collaborate based on either their interest in environmental issues and management, spatial sciences and GIS, or ICT. They could be members of interest groups or organisations, either involved in on-ground environmental management, the collection of information, or the development of information systems. The reason for including people with ICT expertise was to provide for the possibility that they might contribute their ICT expertise and/or develop applications. Participation was also open to any other interested individuals. An ethical consideration was not wasting the time of those who had no interest. To be able to determine this I focussed on people I knew, but did not preclude others.

While this method of selection was purposeful, there was also a degree of randomness and serendipity in the selection. This is supported by Bradshaw and Stratford (2010) as allowing an awareness and openness to unforeseen potential participants that could provide valuable perspectives. For example, an invitation to participate might arise from an unplanned interaction and conversation in which the research was discussed. Therefore, while people with a particular expertise or interest were sought, this was also not restrictive, aiming to allow for self-selection from anyone interested. The aim was not for a particular number of participants to achieve statistical representativeness, but rather for quality of participation (Bradshaw & Stratford 2010). This methodology was exploratory (Kemmis and McTaggart 2005) as what was representative presumed knowledge of the emerging field of GeoWeb 2.0. The concern was more with the quality of participation “with a small number of the right people” (Bradshaw & Stratford 2010, p.75), where the right people were informed by localness, interest, and expertise, or lack of it. This follows Bradbury and Reason’s (2001) measure of quality in Action Research as being explicit in developing praxis of relational participation.

In total, there were 85 participants throughout the research, with 66 predominantly in Stage 1 and 19 new participants in Stage 2 (Table 3-1). The main area of interest or expertise of participants was Environmental (54), then Geospatial (16) and 15 participants had another interest or area of expertise. Within these broad areas participants had a diversity of specific

areas of interest and expertise as shown in column 1. Of those, 32 were acting in a personal capacity and 53 in a professional capacity or context.

Table 3-1: Number of participants in each stage, capacity or context of participation and areas of interest and expertise

	Stage 1 – capacity / context		Stage 1 Total	Stage 2 - capacity		Stage 2 Total	Grand Total
Expertise / Interest	Personal	Professional		Personal	Professional		
Environmental	12	28	40	9	5	14	54
Biodiversity		3	3				3
Birds		1	1				1
Bushfire		1	1				1
Coastcare				7		7	7
Community				1		1	1
Contamination		1	1				1
Education	1		1				1
Environment	3		3				3
Geospatial	4	1	5				5
Information					1	1	1
Management		13	13				13
Natural Resource Management	2	2	4	1	3	4	8
Noise		1	1				1
Planning		3	3				3
Research	1	2	3				3
Weather					1	1	1
Research	1		1				1
Geospatial	7	8	15	1		1	16
Consultant		2	2				2
Environment		1	1				1
Geospatial		1	1				1
Geospatial consultant	2		2				2
Geospatial Environment	1		1				1
Open source				1		1	1
Planning		1	1				1
Research	4	3	7				7
Other	3	8	11		4	4	15
Architecture	1		1				1
Computer Science		2	2		3	3	5
Education	2		2				2
Engineering		1	1				1
Geography		3	3		1	1	4
Information management		2	2				2
Grand Total	22	44	66	10	9	19	85

3.3.3 Ethics and risks of participation

Careful consideration of ethical issues relating to participation, in particular the gaining of informed consent (Mason 2002) was required. The main methods for addressing these concerns were through the University of Tasmania's ethics approval process, as well as my ongoing reflexive consideration. They concerned both the impacts of participation in the research upon the participants, as well as on other aspects and phenomenon about which information may be volunteered and made public. Importantly, part of this was not to disclose the identity of any of the participants, what they said or did, without explicit permission.

The most specific risk anticipated for community participants in the online research related to privacy and security. As with participation in any online forum or platform, participants were advised to consider carefully how much personal information they disclosed. Any information they shared online might be used by others with implications for privacy, security and reputation. The ethics of the online privacy for participants was addressed generally in the participant advice, but the issue of informed consent is complicated by the potential for capabilities that may not be widely understood, such as the spatial referencing of geotagged photographs or tracking of user's mobile phones. Regarding participant's sharing intellectual property online, I had no control over how information shared online was subsequently used. Another risk related to information participants might share about sensitive subjects and phenomenon. This could include disclosing the identities of other participants and community members. As the research progressed, feedback from participants and how they acted led me to reassess the ethics of the research methodology that sought to encourage online participation and sharing of information.

As well as online participation, many interactions occurred offline. To capture this full range of participation, I used a participant observation approach (Kearns 2010), focussing on any activity significant to the research topic. Data derived from this participant observation was recorded in my research journal. It was not always possible to pre-determine who might be a participant. Rather it was determined by whether the nature of the interaction was relevant to the research questions. Insights often came unbidden and serendipitously from what were unplanned conversations and openness to these encounters was maintained throughout. Participation that was often serendipitous raised issues regarding gaining informed consent; these are discussed more fully in Section 6.5.

Prioritizing the ethical consideration for not wasting the time of uninterested participants and recruiting amongst participants already known to myself was initially a severe limit on the sample population. This introduced a strong bias and, together with presumption of *a priori* knowledge of GeoWeb 2.0, places limitations on being able to claim generality for the results. I contend, however, that the nature of GeoWeb 2.0 as a complex adaptive system, and assumptions regarding *a priori* knowledge of such a CAS, are problems that apply equally to other methodologies such as case study and surveys.

3.4 Online Participant Action Research

In Stage 1, PAR was implemented online to assess the potential of free online GeoWeb 2.0 services (FGW2S) for community based sharing of environmental information. FGW2S, applications and platforms were thought to present the lowest barriers to participation by individuals (Shirky 2008, 2010). The rate of change in Web 2.0 raised issues of whether any specialist portal or structure would quickly become out of date, whereas freely available Web 2.0 software, services and platforms were constantly evolving. Market forces drive the continued development and evolution of these tools towards increasing functionality, with popular services gaining most from high participation (Anderson 2007; O'Reilly 2005; O'Reilly 2007). Many choices were available, as set out in the Gov 2.0 toolbox (Dellow 2009) and other descriptions of Social media (George Patterson Y.R. 2011; Parker 2011) and included wikis, blogs, podcasting, photograph and video sharing services (Anderson 2012).

Web applications, sites and platforms using or pertaining to developments in GeoWeb 2.0, especially those aiming to deal with environmental information were reviewed. The purpose was to identify resources that could be used within the research as well as the degree to which Web 2.0 characteristics had been incorporated into applications. Regarding the time taken to review or try to use such web sites, ten minutes was initially allocated and if the use was not clear they were considered not to meet Web 2.0 criteria of being easy to use. As the research progressed, additional options suggested by participants led to further discoveries, for example, the Victorian government website wePlan led to the work of Brown and colleagues and PPGIS (Brown & Weber 2011; Brown, Weber & Zanon 2009).

3.4.1 The State of Our Environment

A participatory mapping platform was chosen for sharing spatial information, a wiki for related text, and other platforms for related multimedia such as photographs and videos. This collection of FGW2S was named “State of Our Environment” (SoOE) to show the relationship to “State of the Environment” (SOE) reporting, but also to distinguish it and highlight participatory and inclusive aims. The acronym “SoOE” was meant to be an easily identifiable badge for the loose coupling of contributing elements allowing anyone else to associate with this approach by using the same term. Loose coupling was described by O’Reilly (2005) as a hallmark of Web 2.0 applications, allowing re-organisation to occur easily, and also a feature of complex adaptive systems (Harris 2007). The SoOE constituted an open online interactive and collaborative space where those with access could create a broad variety of information; a “digital Agora”, similar to the Greek market place where people would meet, discuss, share and debate ideas, as expressed by Tapscott and Williams (2008).

The SoOE FGW2S were used to explain and demonstrate how I thought GeoWeb 2.0 could be used for sharing environmental information, and to conduct parts of the research. Creating these examples was part of my participation as an insider seeking to improve their own professional practice and situation using an auto-ethnographical approach (Herr & Anderson 2005). The focus of the demonstrations was to use simple examples, and to show the possibility that many people could easily undertake similar information sharing. The intention was to investigate ease of use, not to become an expert in Web 2.0 software or applications, but to explore what could be done without programming and high levels of expertise.

Largely this meant focussing on issues relevant to the local neighbourhood and near home or work around the suburbs of Rose Bay, Sandy Bay and Hobart city, Tasmania. PAR is a methodology that is mostly concerned with local issues and knowledge, and strongly situated in time and place (Herr & Anderson 2005; Kemmis & McTaggart 2005). Harris (2007) describes the importance of local, small scale factors in ecological systems. This component of the research also focussed mainly on a local context as it was considered more complex and broader scale information sharing was being addressed by existing initiatives (Australia 2010, 2011a).

Within this local focus, the aim was also to be open, to demonstrate no fixed perspective of what constituted relevant information or how it should be represented. To this end, information

was incorporated across diverse subject matter and on topics that might not otherwise be thought relevant, such as public seating for rest and reflection. To demonstrate the potential for multiple representations, various formats such as text, photos, videos, documents and other web sites were used. Leaving information unpolished and incomplete, following the Web 2.0 approach of “worse is better”, provided the possibility for others to participate by correcting and improving.

3.4.2 Participating in the SoOE

Participants were invited to collaborate in use and the investigation of the SoOE. Invitations to participate could be from myself as principal researcher and administrator of the FGW2S, or by any other person who had registered to participate. For participants to collaborate online they needed to register on each platform and were then able to contribute or edit any information. Particular PAR techniques that could be supported through this medium were participatory and collaborative mapping, knowledge creation and deliberation (Kindon 2010). The people who were invited to contribute were generally related to my residential or work locality. While the primary focus of the research was initially the local context, information and people from wider perspectives and localities were not precluded, and integrated as the research progressed.

No restrictions were placed on who could view the sites or participate, except that any antisocial behaviour⁴ would result in being barred from participating. As all the applications were viewable by anyone with internet access, participants were also conceived as anyone who viewed the SoOE. On the SoOE and in the participant information sheet the language used was chosen to encourage people to participate. These collaboration capabilities, and communicating about them, were important parts of transparency and openness, and making the research collaborative. Additionally, transparency was achieved by making publicly available online many of the documents created through the research.

Offline participation was not initially expected to be a major component, but was not precluded. Offline discussions and interactions in face to face conversations, emails, meetings, and telephone conversations developed into participation relevant to the research. Records of these were kept in the research journal, copies of emails, meeting minutes and written reports on

⁴ Elaborated upon in PAR 1, Section 4.1.3

interactions. Site visits were conducted to collect data, to work with groups to jointly assess developments and to understand the context and perspective of other research participants. Within this thesis I use pseudonyms to refer to participant's contributions or activities.

3.4.3 Data collection and direction

Kemmis and McTaggart's (2005) description of the fruits of PAR as changes in what people do, how they interact with the world, what they mean, value and their discourses, suggested the following three main types of data about participation as most relevant:

- what participants did or did not do
- what participants created or destroyed and
- what participants thought about what they did or did not do.

These three data sources also correlate broadly with Kearns' (2010) description of the range of purposes for observation as counting, complementing and contextualising. Both quantitative and qualitative data could be collected regarding these three aspects of the participants and their behaviour. The three data sources provide triangulation with each providing insights into the other, resulting in a more complex knowledge of the research subject.

After having been invited or informed of the SoOE, data were collected on how participants interacted with, created or removed content, was recorded by the FW2S used, a spreadsheet and my journal notes. Also of interest were any correlations in behaviour between participants and with the activities of the research leader. The characteristics of who participated were considered important qualitative data. Most relevant was the participant's area of expertise or interest, and this was assessed from the researcher's knowledge of the participants. Critical reflexivity was used to address my assumptions regarding participant's expertise but with hindsight additional rigour could have been provided with a questionnaire or survey. What people improved, added or created, such as information and new applications, was considered an indication of a practical rather than theoretical type of engagement. Quantitative measures included the number of edits made, number of sites added to the map, number of applications added or modified. Data on how participants interacted with, created or removed content, was recorded by the Wiki software, a spreadsheet and my journal notes.

The qualitative nature of participant contributions both on and offline also provided insights into the topics deemed important by participants, whether they were supportive of the research

goals, and indicative of the degree of participant engagement or antagonism. This assessment can be informed by quantitative data, such as field measurements of the accuracy of a site added to the map; however, quality and accuracy are not always commensurate except in the most obviously “wrong” situations. An inaccurate observation may still be fit for purpose. How well a creative addition supports the research goal also then relies partly on consideration of the intention of the participant. Hence data on what participants think about what they do or not do, create or destroy are essential.

Data on participants’ perceptions of their own and others beliefs and actions and understanding of the research topic was used to inform the research direction, assess its quality, and to add participants’ understanding to propositional knowledge. Understanding why people might or might not participate in such a project informs its direction. For example, if the overall aim of the project is not considered useful or achievable, then the project has identified an important barrier to participation and must be adjusted. The research can then continue, identifying other barriers and bridges in the research journey.

What participants think and feel is the most problematical information to source, as only the participants know why they do what they do. It is very hard for any outsider to access this information reliably, as “neither observation nor theory provides sufficient understanding to be sure of those intentions” (Flood 2010, p.276), yet it has high potential explanatory power. The original method planned to gain this knowledge was through interviews and indicative questions were approved as part of the University of Tasmania’s Human Research Ethics Committee ethics approval. Several interviews were conducted using this method. It did not, however, constitute a major data collection method as I discovered that participants volunteered information and perspectives, often without my prompting. This volunteering was considered more “natural” and less likely to be as biased as the more contrived rigidity and formality of a survey or interview. Kelly and Mock et al. (2001) refer to the naiveté of survey methods that presume to know what is important to ask and advise that the choice of method be ‘ecologically sensitive’ to context (cited by Bradbury & Reason 2001, p.452). The interview questions formed the initial basis for the types of responses of interest during conversations and interactions. They did not, however, represent the only information of interest, and openness to what others might volunteer freely was given as much importance as what was gained by prompting.

The data collected was used to inform the PAR recursive cycles of action, reflection and further action. Visits to the SoOE, registrations, the addition of data points and other volunteered information were interpreted as indicators of what participants considered interesting, relevant or important. There are, however, limitations from the different modes of observation. For example, a view of a SoOE page could be an indication of the level of interest for the subject matter of that page, but there is also the possibility of accidental viewing, in which the viewer immediately moves on. A better measure then becomes how long the viewer stays on the page before moving on, although a longer stay can just as easily be accidental, such as if the viewer's attention was distracted. Proper consideration of these issues influences the trustworthiness of the data.

Researcher reports called “SoOE update reports” were written at the end of each PAR cycle, sent to participants and uploaded to the SoOE Wiki.. These SoOE reports also often contained my ongoing analysis, reflexivity and consideration of the effect of research position. Over the first stage I wrote and distributed six update reports (Table 3-1). Parts of the update reports have been provided in the results, together with additional data, references and perspectives provided by time and hindsight. The update reports reiterated that anyone who wanted to become a collaborator could do so via an email request.

Table 3-1: SoOE update reports and date distributed.

Report Document Name	Date added to SoOE Wiki
SoOE_Report_1_FebMar11.doc	21/03/2011
SoOE_Report_2_AprMay11.doc	6/06/2011
SoOE_Report_3_JunJul11.doc	19/08/2011
SoOE_Report_4_AugSeptOct11.docx	4/11/2011
SoOE_Update_Report_No5_NovDec11_FebMar12.docx	27/03/2012
SoOE_Update_Report_No6_July12.docx	1/08/2012

An important role of update reports was as a member check (Bradshaw & Stratford 2010), feedback from the researcher to participants that allows participants to assess the validity of the researcher's observations. Overall the SoOE was available and participants interacted with it from February 2011 until July 2012. Regular meetings were conducted with my supervisors throughout the research. At these meetings, progress was communicated, problems discussed and strategies formulated.

As well as the journal, the use of the SoOE online, including data such as photographs and presentations, provides a record of the site in which the research was conducted. The major data sources describing the SoOE are the list of applications used and content within each of these, the wiki pages and statistics as described in the results. Thus, the full social and geographic context of the research can be understood (Anderson, Adey & Bevan 2010). Data collection continued from Stage 1 through Stage 2 with the observations and interactions all incorporated into the results. Other data sources are the literature (grey and formal), online platforms reviewed, key informant interviews and my experiences. The data sources were selected based on participant feedback, developments at the time relevant to the research topic, the emerging research results and context.

3.5 Summary

This chapter described the influences on the choice of methodology as following GeoWeb 2.0 approach of engage and co-create, ethical concerns regarding research with the community, and the practical reason that the community could provide important resources for the research. The overall approach of Action Research (AR) was selected as best aligning with the nature of the research subject and ethical concerns. AR and the version of AR implemented in Stage 1, Participant Action Research (PAR), were described. Alternative and expanded criteria for rigour, validity and quality, as compared to other research traditions, were established as appropriate to the worldview of AR and PAR. In this respect, this chapter addresses the broader quality criterion of process validity by articulating how AR and PAR constitute sound and appropriate methodologies for this research.

The similarity of PAR's recursive cycles of implementation to models of environmental management and complexity aligns the research methodology with processes in the research subjects. The role of PAR in facilitating participation, and its relationship to GIS-mediated participation, qualifies it as a methodology appropriate for investigating community participation through GeoWeb 2.0. Critical reflexivity provides a method for addressing quality concerns and other issues arising from community and my own participation. How participants were recruited, the ethical concerns and risks arising from participation, and data collection have been addressed. Finally, this chapter has outlined the methods used in Stage 1 to implement PAR online through a collection of FGW2S named the SoOE, data collection and direction of the research.

I now describe the results of Stage 1, with PAR cycles 1-3 incorporated in Chapter 4 and PAR cycles 4-6 in Chapter 5.

Chapter 4 **Online wikis and maps (early 2011)**

This chapter describes the results of PAR cycles 1-3. For each I describe firstly my online participation that included writing about the research on the SoOE Wiki, adding examples to the SoOE Map to illustrate the concepts and using these to influence environmental management. The pages created for the SoOE wiki are listed in the Appendix (Table A-1). The online participation of others is then described, followed by what happened offline. Online collaboration is set out in three parts that match the types of data sought: what people did, created or destroyed, and thought. For the first I rely mainly upon the online statistics of views broken down by visits, unique views, pages visited and country of origin. For the second I refer to the data added, that included sites added to the map and additions to the wiki. For the last I made interpretative assessments of what people said and did. Secondary sources of data reviewed – the literature, academic and grey – and other web sources, are referenced or listed within the relevant context and discussion. The last part of each cycle is a reflection on that cycle, including how I incorporated reflexivity into the project.

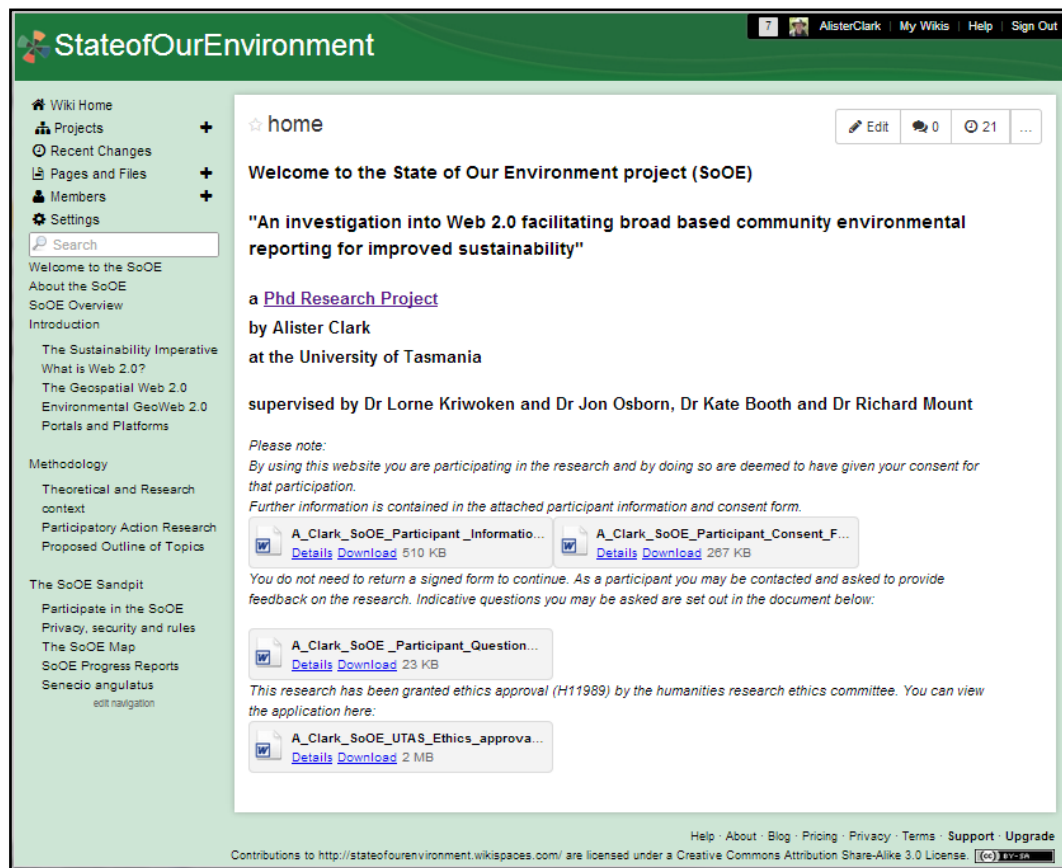
4.1 PAR 1: Creating the SoOE

In PAR cycle 1, 31 January 2011 to 21 March 2011, the online collaboration platform named “State of Our Environment” (SoOE) was created. Research journal pages 1-29 cover this period, and include rough notes that were kept before the journal was started. The first decision involved choosing FGW2S for describing the research. For textual information, options included wikis, blogs and online document sharing applications. A wiki, Wikispaces (2011), was chosen as the main media for text as it provided the most flexibility for interaction, allowing participants to edit and comment on pages within the wiki, and because people were expected to be familiar with the concept of a wiki due to the popularity of Wikipedia (Tancer 2009). Wikispaces also collected many statistics on application usage and these are explained in more detail below.

The wiki called the “StateofOurEnvironment” was created, referred to herein as the SoOE Wiki. The lack of spaces came from the URL naming requirements, but also meant that the name could be distinguished in search engines from other general usage. On the SoOE Wiki I began writing about the research, its aims and objectives. The home page (Figure 4-1) introduced the research title and the main researchers. It also explained that anyone using the

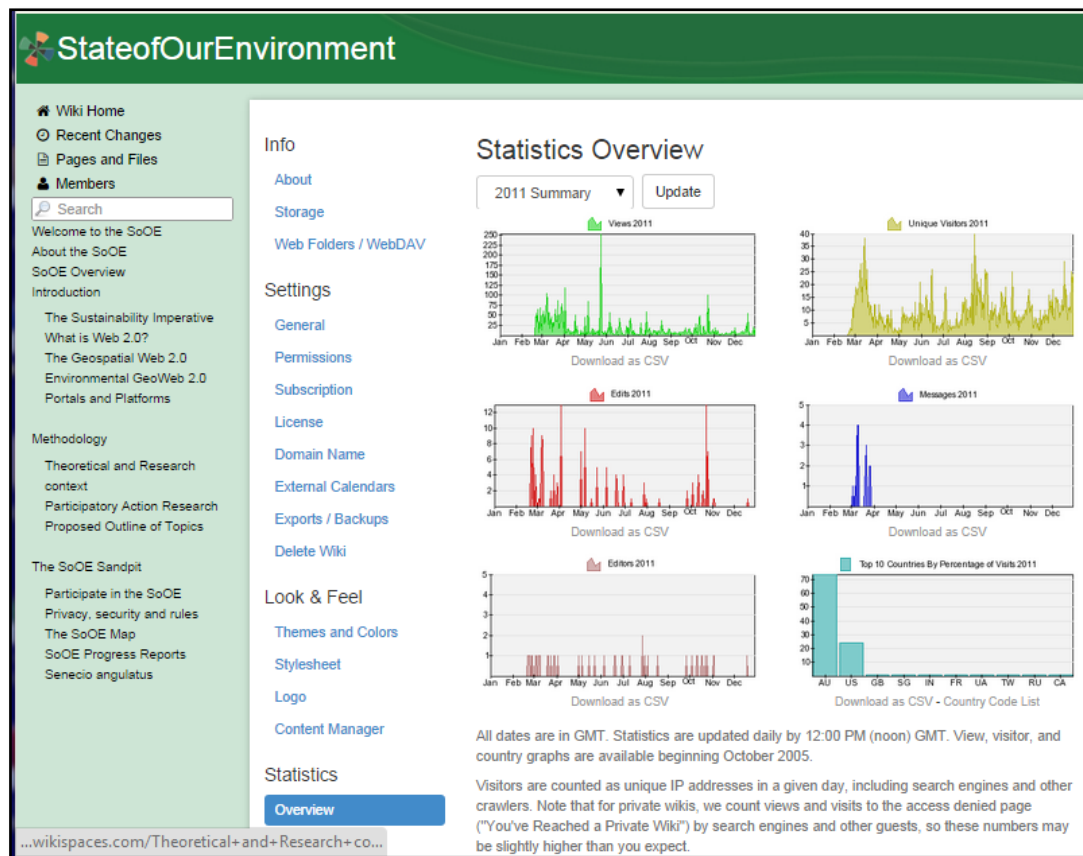
web site was deemed as having given consent to participate in the research. Included were links to documents containing Participant Information, Consent Forms and Participant Questions and the University of Tasmania's Human Research Ethics Committee approval. The URLs of online resources created through this research are included as footnotes, rather than in endnotes, for ease of reference.

Figure 4-1: Home page of the SoOE Wiki⁵



Wikispaces registered the pages and files created, the members invited and registered, the wiki settings and site usage statistics on number of views, unique visitors, edits and revisions, posts and messages. These were downloaded into an excel spreadsheet as data. Members of the SoOE Wiki could view the statistics for the Wiki at any time on the statistics page (Figure 4-2). Those registered (collaborators) could see how many other collaborators there were by clicking on the “collaborate” button.

⁵ <http://stateofourenvironment.wikispaces.com/>

Figure 4-2: SoOE Wiki Statistics Overview page, summary for 2011⁶

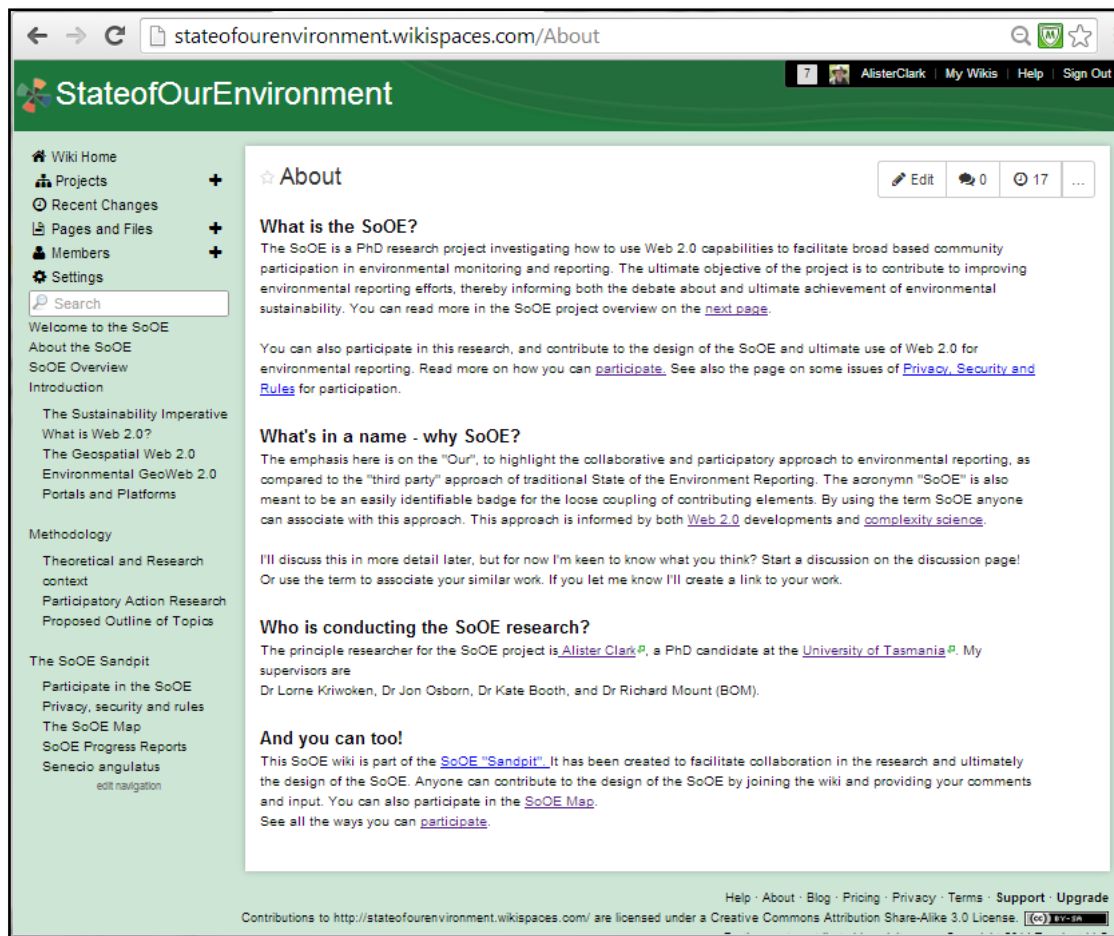
A more detailed description of the SoOE, the basis of the name, who was conducting the research and how it was meant to be broadly collaborative, was provided on the page “About the SoOE” (Figure 4-3). The page “Overview”⁷ introduced sustainability issues, the initial aims of the research and proposed methods and the relationship of complexity theory. “The Sustainability Imperative” described the environmental focus of the research, and “What is Web 2.0” described my initial understanding of the technological developments of interest introduced in Section 2.1. At the time I wrote:

*As a relatively new and fast changing phenomena, it (Web 2.0) is unlikely to have been the subject of much rigorous research and hence not well described in the scientific literature, but I must admit I haven't tested this supposition well. It is however the subject of recent and popular journalism.*⁸

⁶ <http://stateofourenvironment.wikispaces.com/space/stats/overview/2011>

⁷ <http://stateofourenvironment.wikispaces.com/Overview>

⁸ <https://stateofourenvironment.wikispaces.com/What+is+Web+2.0%3F>

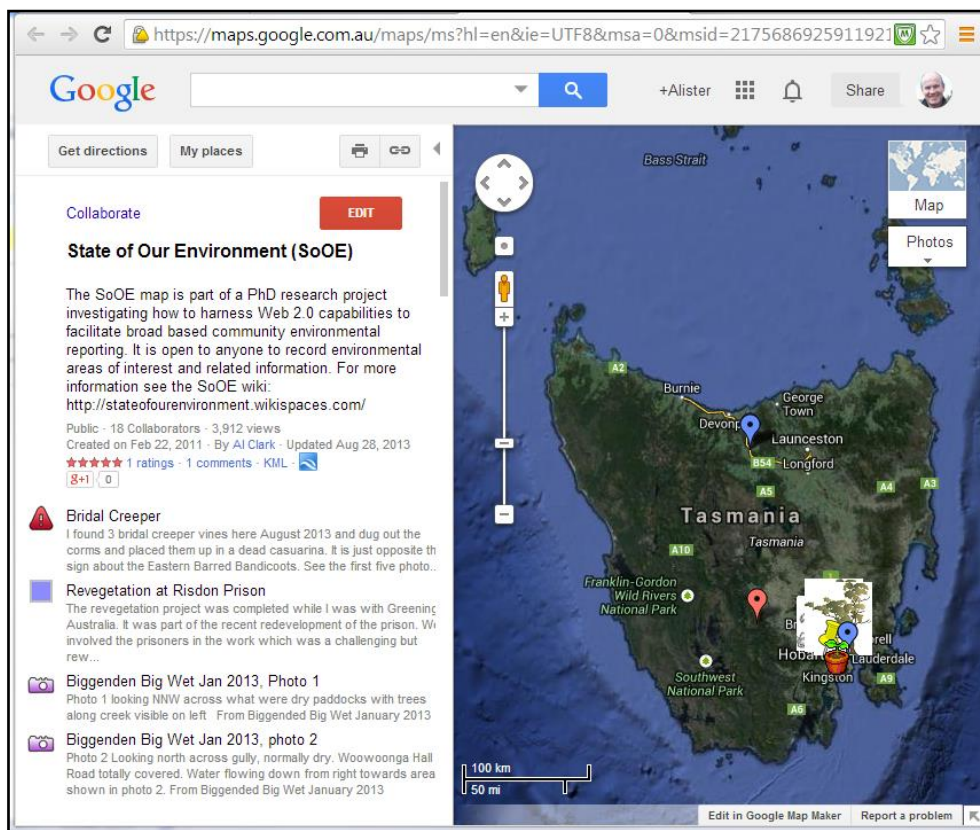
Figure 4-3: “About” page describing the research⁹

I now understand this perspective as influenced by the position from which the research commenced, and hence the visibility and availability of relevant research. The page “Theoretical and Research Context” provided the rationale and context for the research. These pages have mostly been left unchanged from their initial drafts as a record of the starting position of the research. The SoOE Wiki was linked to the page “Map” which described in more detail the SoOE Map. Note that this link appears under the heading “The SoOE Sandpit” which likens the loosely coupled FGW2S as similar to a sandpit to experiment and play in, following Kemmis and McTaggart’s (2005, p.580) advice for “playfulness” in PAR. This again was meant to reduce perceptions by prospective participants that contributions had to be perfect or professional.

⁹ <http://stateofourenvironment.wikispaces.com/About>

Many FGW2S allowed the collaborative collection and sharing of spatial information. Well known and easy to use options were the MyMaps facilities provided by Google Maps (Google 2011b), Yahoo (Yahoo!), Bing (Microsoft 2011), and MapQuest (MapQuest 2011). Google MyMaps was chosen because it was the most widely used (Alexa 2011) and most intuitive to use. A public Google MyMap was created called State of Our Environment, referred to herein as the SoOE Map (Figure 4-4).¹⁰

Figure 4-4: SoOE Map

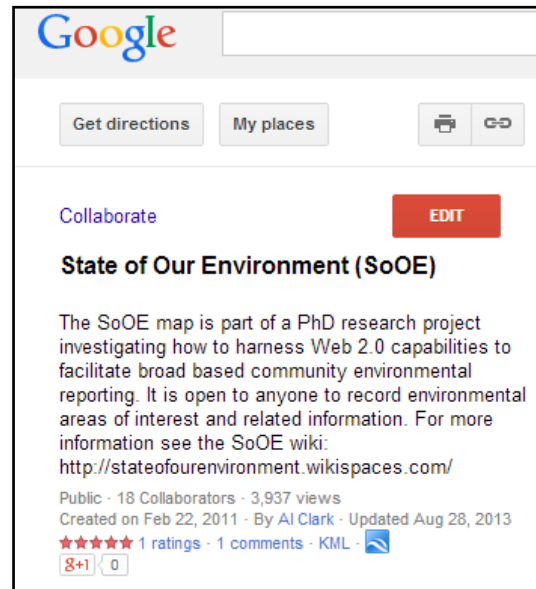


Once a participant registered on the SoOE Map they became a collaborator and could edit and change any information added to the service. The SoOE Map recorded who had registered and only the number of views of the overall map (Figure 4-5). To supplement the Wiki, the concept of sharing environmental information was illustrated through populating the SoOE Map with examples. The sites added to the SoOE Map in PAR 1 are listed in the Appendix (

¹⁰ <https://maps.google.com.au/maps/ms?msid=217568692591192122146.00049ce5c93a2be068ad3&msa=0&ll=-42.895082,147.34314&spn=0.620753,1.234589>

Table A-2).

Figure 4-5: Descriptive panel on SoOE Map showing number of collaborators and views, August 2014.

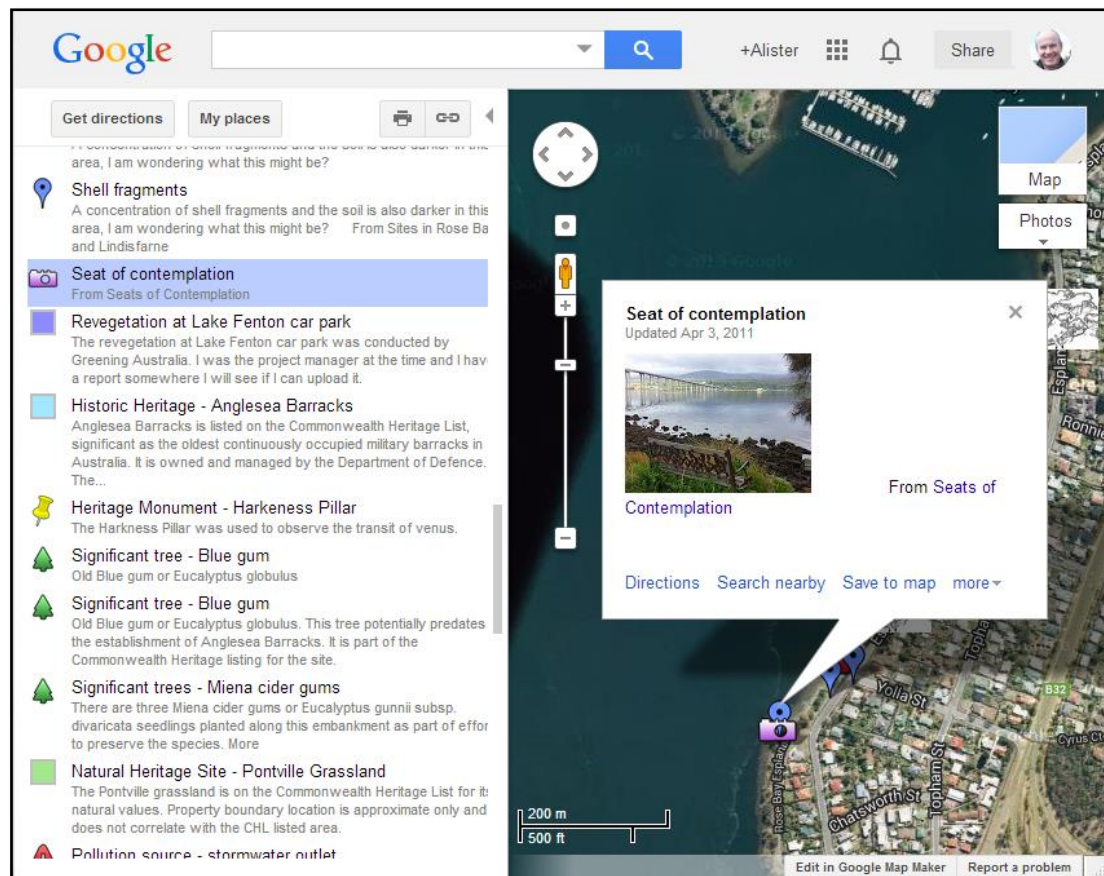


Within the SoOE Map, a diversity of subject matter was incorporated, represented in various forms with markers for locations, text and other media inserted or linked to. The site “Seat of contemplation” (Figure 4-6) demonstrated how aspects additional to physical items, such as affordances, relations and relationships can be captured. What cannot be captured in the digital representation is the comparative warmth of this wooden seat. Other such seats had been replaced by more durable but colder aluminium, cause for further reflection on the relative merits of efficiency and efficacy. The dialogue box links to the location of the photograph online in the Picasa™ Web album¹¹ “Seats of Contemplation”. The phrase on bottom line right “Edit in Google Map Maker” is a recent addition as this facility was not available when the map was first created, an example of the dynamism of the applications. The site “Significant tree – old Eucalyptus viminalis (sic)”, with a video¹² of birds in the tree (Figure 4-7) incorporating the bird calls suggests how giving voice to others as described by Sui and deLyser (2011) can be accommodated.

¹¹ <https://picasaweb.google.com/112710630524165862583/SeatsOfContemplation?feat=embedwebsite>

¹² <https://www.youtube.com/watch?v=nK4majuW04U>

Figure 4-6: Adding photographs to locations in the SoOE Map

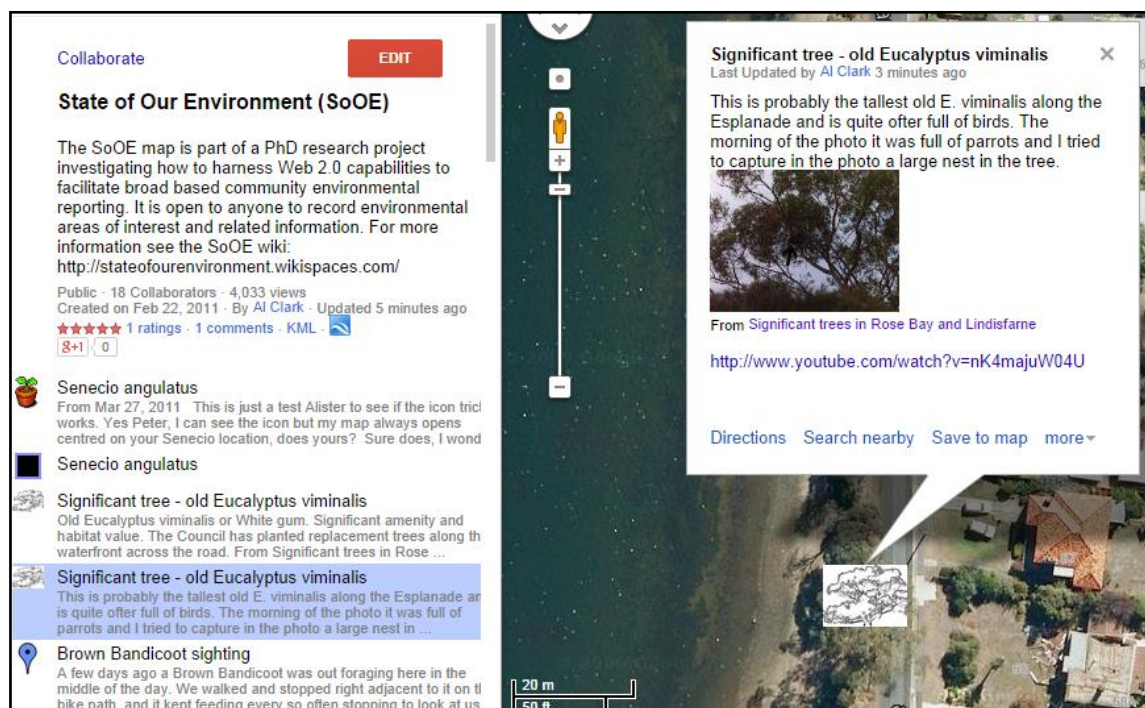


These examples demonstrate a significant difference in the way Google MyMaps stores attributes of sites compared to desktop GIS such as ArcGIS. In the latter, at least three separate files are required to related the attribute table to spatial information files. They must be stored together and the process of creating attribute tables requires learning the method used by the software. Google MyMaps uses hyperlinking, a flexible method for diverse information to be attributed to a location. While the hyperlinks are all stored together in the MyMap xml file, the hyperlinking capability can be interpreted as an instance example of loose coupling and what Elwood, Schuurman and Wilson (2011) describe as the opening up of the rigidity of traditional GIS, “to de-tether GIS from its fixed usages” (p.95).

Also, sites added to the SoOE Map initially described as indigenous heritage sites (2-5) attracted immediate feedback as undesirable ethically and possibly illegal. This created the problem of how to deal with issues of disclosure and my first practical experience that total openness and disclosure is not always desirable. The digitising of indigenous sites introduced the potential role of GeoWeb 2.0 in land rights claims and is described in the literature on

community mapping. Corbett and Rambaldi (2009) describe how community mapping can be a powerful contribution to social justice initiatives, but that initiatives rely on networks of assistance with outside groups to facilitate mapping with skill and delicacy within the complexity of existing roles and associations. Brown and Nicholas (2012) also caution that digital media often exacerbate existing limitations of conventional law in protecting expressions of indigenous cultural and intellectual property.

Figure 4-7: SoOE Map site “Significant tree – old *Eucalyptus viminalis*”, with link to YouTube video of birds in the tree



4.1.1 Inviting collaborators

Deciding who to invite to collaborate, inviting them, describing the research, and how to participate and collaborate was also a primary activity in PAR 1. Both the SoOE Wiki and Map provided a mechanism to send an invitation using a standard email (

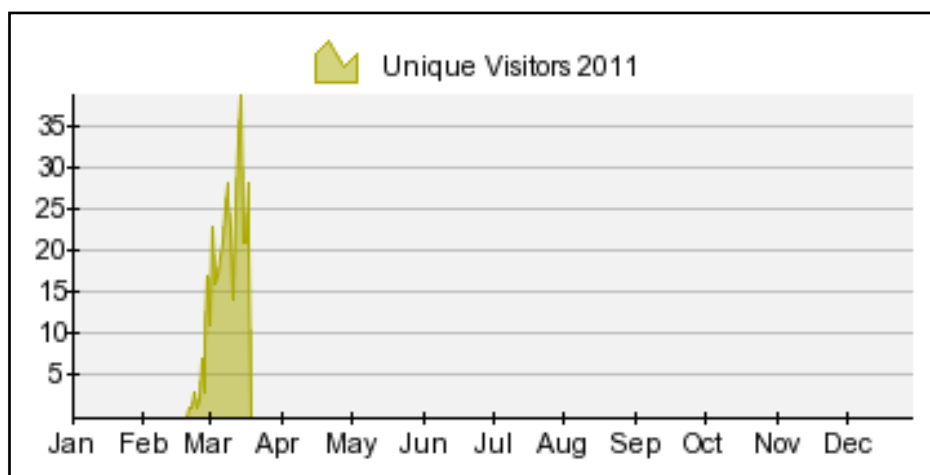
Figure A-1). It was possible to edit this standard email before it was sent to change the invitation or add additional information. Because of this I did not know if others might send out additional email invitations. Participants could also go to either the SoOE Map or Wiki, and request to participate by an email request. The sites were open to discovery through internet searches or browsing. During PAR 1, 23 invites to participate were sent using the standard

emails from the wiki and map with a link supplied to register. For advice on how to participate and collaborate the wiki page “Participate in the SoOE”¹³ (

Figure A-2) was drafted. To facilitate participation by being transparent about my intended future directions, the page “Proposed outline of topics”¹⁴ was added to the wiki, and participants were invited to suggest alternative directions. No comments were received. It is possible no-one looked at the list, or the list was too long, and it presumed some a priori knowledge of the subject area. I also registered under a pseudonym to view the applications from the perspective of a non-administrator.

On the 15 March 2011, the Wiki recorded 39 unique visitors on one day (Figure 4-8), while I had invited only 23 people.

Figure 4-8: SoOE Wiki unique visitors, first month up to 21/3/2011



My online activities did not constitute any of those visits. Some of these visitors were from the USA (US) and Great Britain (GB) (

Figure 4-9) demonstrating the publishing and communication reached beyond local social and geographical contexts.

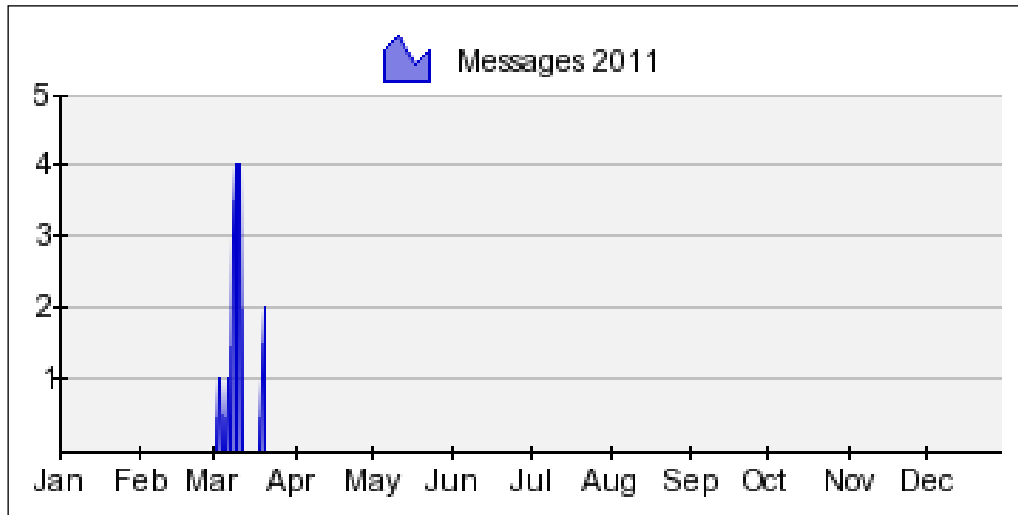
Table 4-1 shows a summary of the number of visits to each Wiki page. The visits to pages with their creation date ordered from oldest to newest, left to right (Figure 4-10) shows that some newer pages attract proportionally more interest than older pages, in particular the Map

¹³ <https://stateofourenvironment.wikispaces.com/Participate+in+the+SoOE>

¹⁴ <http://stateofourenvironment.wikispaces.com/Proposed+Outline+of+Topics>

page. During PAR 1, nine participants became members of the SoOE Wiki. Of the eleven members (I am the extra two), two contributed to discussions, while I was the only editor.

Figure 4-11: SoOE Wiki messages, PAR 1



I did not add the data to the Natural Values Atlas (NVA), a Tasmania State Government online environmental geoportal containing information on Tasmania's natural values such as flora, fauna and geo-conservation sites. The NVA did not incorporate any Web 2.0 functionality, the interface was complex and difficult to use, and I was interested in the participant's actions and reactions to my comments about user assessment of quality. The quality of data was an issue despite the accompanying descriptive page of notes, metadata that includes data quality information, but is less complex than a formal standard approach inaccessible to non-experts (Boin & Hunter 2007; Servigne, Lesage & Libourel 2006).

shows the messages recorded on the Wiki. The messages relate to the interaction shown in Figure 4-12 regarding sharing the polygon entitled "Senecio".

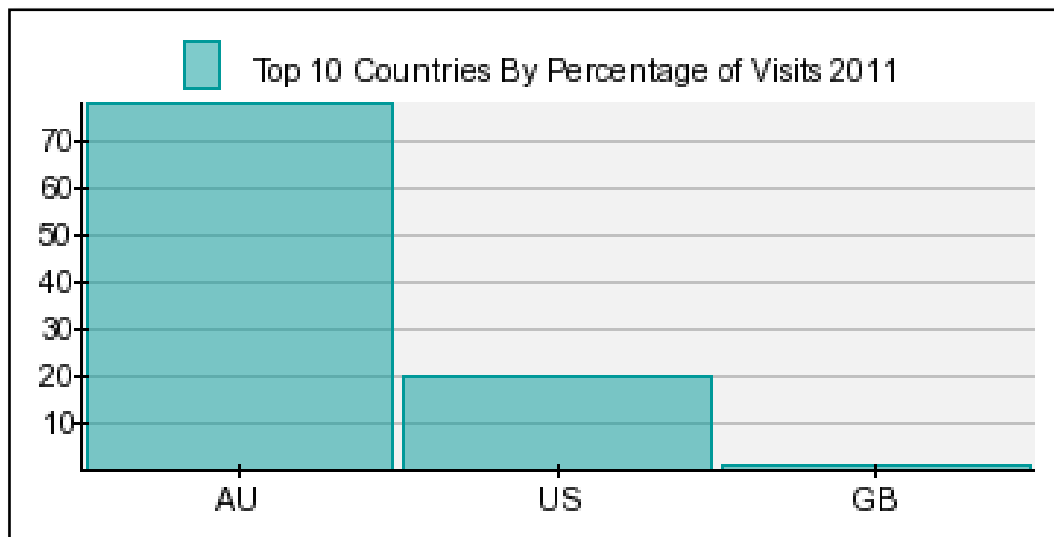
Figure 4-9: SoOE Wiki visitors by country of origin (per cent), up to 21 March 2011¹⁵

Table 4-1: SoOE Wiki visitors to each page in PAR 1

Page Name ▾	Views
About	161
home	321
Map	160
Overview	78
Participate in the SoOE	54
Proposed Outline of Topics	22
Senecio angulatus at South Arm, Tas	86
space.menu	41
The SoOE Sandpit	64
The Sustainability Imperative	44
Theoretical and Research context	33
What is Web 2.0?	30
1 - 12 of 12	

¹⁵ the graph title from wikispaces is labelled 2011, but the sample was conducted on 21 March 2011

Figure 4-10: SoOE Wiki visitors to each page ordered by date created.

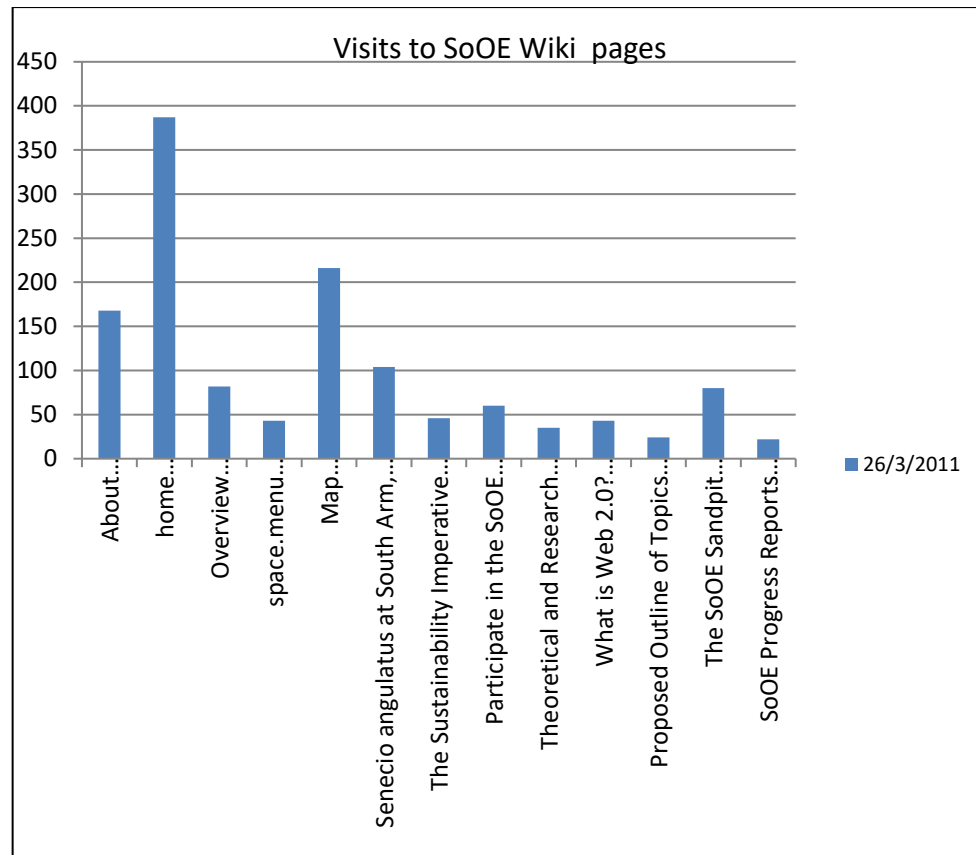
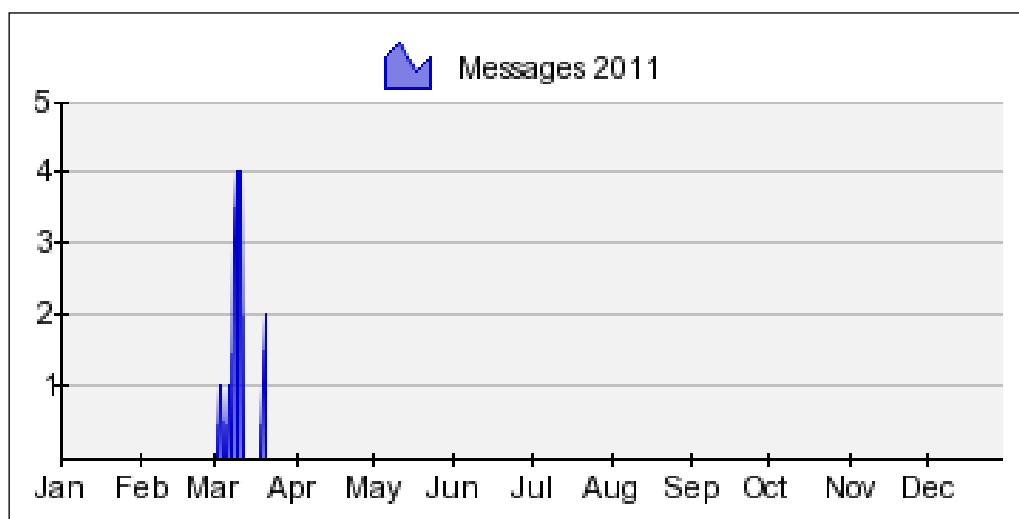


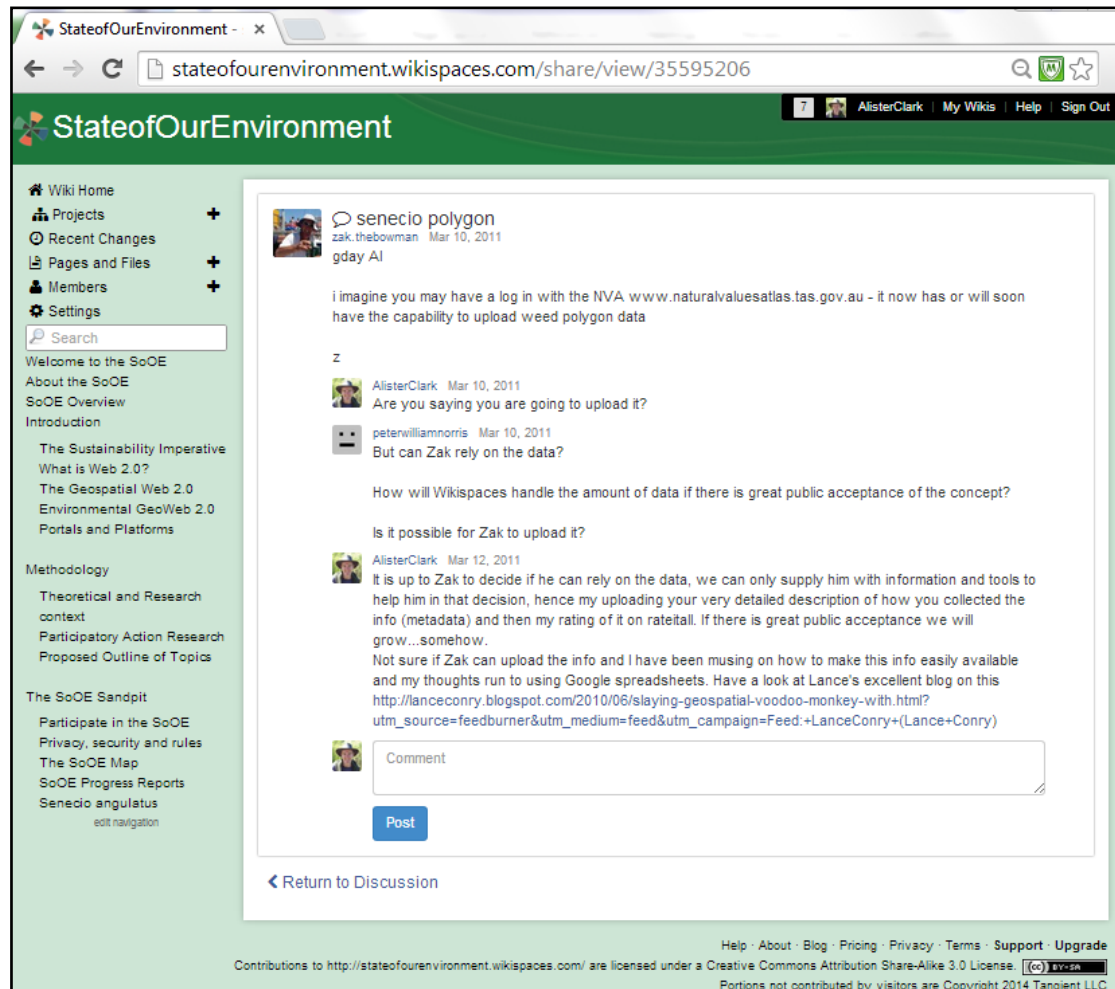
Figure 4-11: SoOE Wiki messages, PAR 1



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interface was complex and difficult to use, and I was interested in the participant's actions and reactions to my comments about user assessment of quality. The quality of data was an issue despite the accompanying descriptive page of notes, metadata that includes data quality information, but is less complex than a formal standard approach inaccessible to non-experts (Boin & Hunter 2007; Servigne, Lesage & Libourel 2006).

Figure 4-12: Online interaction regarding the “Senecio” polygon

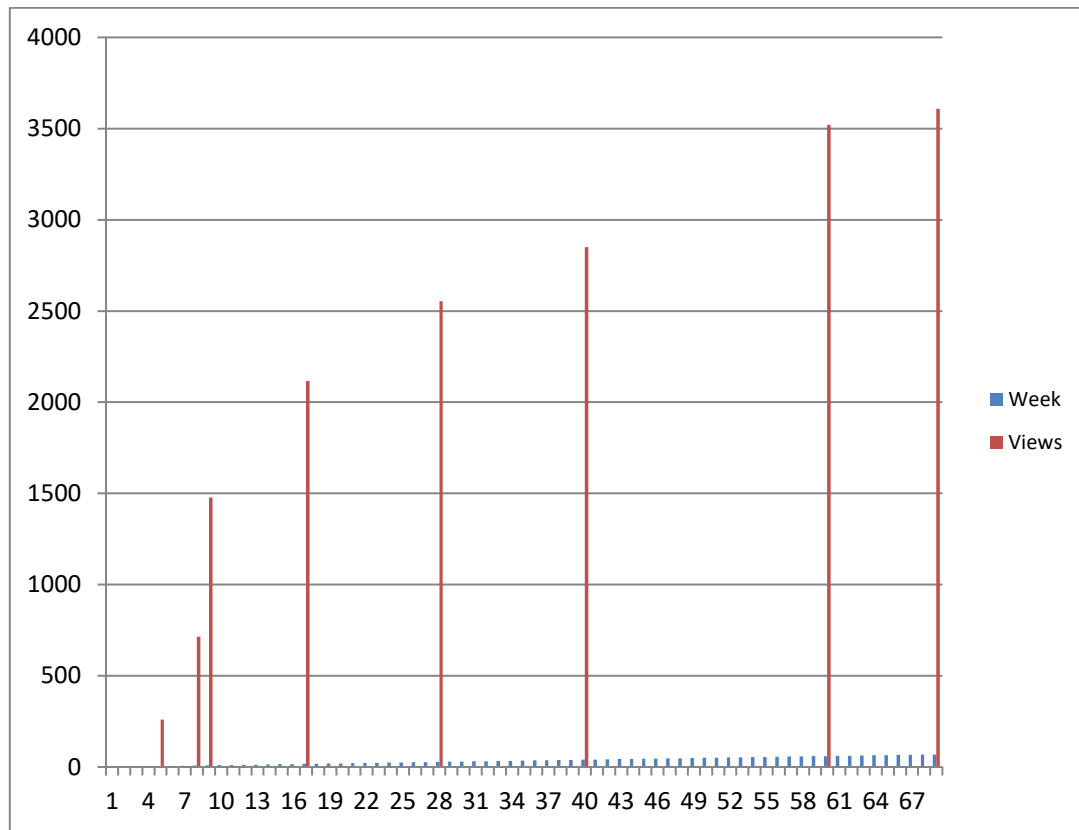


The SoOE Map only recorded the number of views of the overall map.

Figure 4-13 shows visits recorded at selected time intervals over 39 weeks of monitoring from 21 February 2011 to 25 May 2012 (week 69). The trend was for a fast increase in the number of visits early on that then decreased over the time of monitoring. There were over 517 views during PAR 1. No information was available for visits to individual sites within the map.

During PAR 1 there were 9 participants who registered on the SoOE Map but only I added information.

Figure 4-13: Visits to the SoOE Map



X axis = number of views, Y axis is time elapsed from SoOE Map setup

4.1.2 Offline participation

Early in the research feedback was received in emails and offline conversations from both registered and other participants. Email is considered as offline participation as it is essentially still a one to one conversation and hence private. A rewarding collaborative meeting involved a participant, Pierre, who demonstrated how to view the source code in Google MyMaps and to download the data. The desire to back-up data arose from concerns about the long-term security of the data, as times of instability with Google Maps were encountered. How to manage records of the data in the map and data from a back-up of the sites was not straight forward, and Google MyMaps did not supply a simple facility for this at commencement of

use. Pierre made substantial adaptations to the SoOE Map and several additions to the Wiki. Notably, this person was not formally educated in GIS or environmental management, but was a very keen self-taught practitioner. This experience demonstrated how making software code open to viewing, provides the ability to “look under the hood” and adapt applications, such as in open-source software and services with open-source code. I encouraged Pierre to set up their own wiki which they did, but did not progress far. For this participant protecting their intellectual property later became a major barrier to continued participation.

In contrast to the active participation of Pierre, participant Simon who had well-developed technical GIS skills and worked in a professional public service role, questioned why existing GIS, such as ESRI’s ArcGIS wouldn’t be preferential. I posited that the online GIS were more accessible and easier to use for the wider public. They also had concerns that opening to the wider public would create additional demands for data curation, management or action. For them, the potential issues outweighed the potential benefits. Several other meetings with environmental professionals did not produce any actions towards using GeoWeb 2.0 to share information. Simon’s concerns are reflected in the literature in discussions about the confusion of Neogeography and traditional Geography (Goodchild 2009) and later in the potential for trivialisation of professional Geography and Spatial Science (Leszczynski 2014).

4.1.3 Reflections: on simplicity and complexity

Due to concerns the SoOE Map and the information I populated it with was very simple, I reviewed other existing websites and platforms, but none were found as suitable. Creating a mashup or specialist platform required specialist expertise and resources such as programming ability, software and hardware (Batty et al. 2010; Chow 2007). My intention with this research, however, was not to become an expert in the use of Web 2.0 applications or to position myself as one, but to explore what could be done without programming and high levels of expertise.

How the SoOE could evolve without my programming was influenced by readings in complexity theory (Anderson 1999; Gunderson & Holling 2002; Johnson 2001; Phelps & Hase 2005; Snowden 2002, 2003). Snowden (2003) illustrated the difference between a complicated system and a complex adaptive system (CAS) by comparing an aircraft with an organization. The aircraft is complicated, but remains the same aircraft when an engineer walks toward it to conduct repairs. In contrast an organisation, as a complex adaptive system, begins to respond to the news of a restructure even before any action takes place. People in the organisation

discuss the proposed restructure and reorganise themselves accordingly. This response and adaptation to interactions, context or new information, means any “outside” interaction with the CAS must create further change. Gunderson and Holling (1995) describe how ecosystems change in surprising and unexpected ways in response to human attempts to manage natural variability. Law (2004) describes how the process of researching changes the researched. Complexity theory provided insights into how it might be possible to create a complex adaptive SoOE system. Snowden (2003) observes:

in a complex domain we manage to recognize, disrupt, reinforce and seed the emergence of patterns; we allow the interaction of identities to create coherence and meaning (p.25).

Following Snowden’s “Cynefin” model of types of systems as Simple, Complicated, Complex and Chaotic (Figure 4-14), such a SoOE would start in the chaotic, or complex domains, in which the approach for sense-making is to act or probe, then sense and respond.

Figure 4-14: Cynefin complexity framework with all five domains

Complex Probe Sense Respond Emergent		Complicated Sense Analyze Respond Good Practice
	Disorder	
Chaotic Act Sense Respond Novel		Simple Sense Categorize Respond Best Practice

Source: adapted from Wikipedia (2014a)

This domain is also uncharted and innovative, a learning environment of low abstraction in which I would “have neither the experience nor the expertise because the situation is new, the ultimate learning environment” and would have to:

act to create context to enable action through individuals who have either developed specific understanding or are comfortable in conditions of extreme uncertainty. Such individuals or communities impose patterns on chaos to make it both comprehensible and manageable (Snowden 2003, p.25).

Supporting these ideas were descriptions of the PAR process as “probing” (Kemmis & McTaggart 2005) and of the synergies between Action Research and complexity (Phelps & Hase 2005). The SoOE CAS could only be “seeded” to perhaps catalyse action, then observed and guided by reinforcing desirable patterns and dampening down undesirable ones. It is not, however, possible to totally predict or control what will emerge. The appearance of emergent properties can be completely unexpected and surprising, and is identified in descriptions of Web 2.0 (Anderson 2012; Johnson 2001; Macnamara 2010). Taleb (2007) captured this idea with the metaphor of the black swan, which was completely unimaginable by Europeans who had only ever known white swans before they were found in Australia. Hence, my approach was to control what happened as little as possible to see what might emerge, expecting the unexpected.

The next section describes PAR 2 that involved continued developed of the SoOE and other offline participation.

4.2 PAR 2: Online and offline collaboration

Over PAR 2, from 22 March to 6 June 2011, I continued to receive feedback and comments on many aspects of the research and was pointed in the direction of other resources, complementary and similar initiatives. It was difficult to provide ongoing evidence back to all contributors that I had taken their feedback on board by incorporation into the online SoOE. I recorded them in my research journal (pp. 34 – 80).

4.2.1 My online participation

The page “The Geospatial Web 2.0, PPGIS and VGI”¹⁶ began describing my unfolding understanding of how developments in Web 2.0 had intersected with GeoWeb, the terminology being used and related fields of research. Ganapati (2010) wrote about the role of Geospatial Web 2.0 platforms in facilitating public involvement in government, defining such platforms as the “the adaptation of Web GIS to the Web 2.0 environment, wherein spatial data can be overlaid on existing map servers through application programming interfaces (APIs)”. Defining interaction as mediated through an API implies the necessity for programming expertise, when many platforms allow this to occur through graphical user interfaces, a component of increased useability. At this stage I was unaware of how different terminology described GeoWeb 2.0 and its components, and this affected how the phenomenon were perceived and understood. This became clearer as the research progressed and is described in detail in Chapter 9.

In “The Geospatial Web 2.0, PPGIS and VGI”, I also misunderstood Ganapati’s definition of Public Participation Geographic Information Systems (PPGIS) and hence positioned PPGIS as an outcome of GeoWeb 2.0, when it in fact considerably predates this (Sieber 2006). Following on from “The Geospatial Web 2.0, PPGIS and VGI”, the page “Environmental GeoWeb 2.0 Portals and Platforms”¹⁷ outlined applications of GeoWeb 2.0 for environmental sustainability and management. More details on selected applications were provided on the pages “Atlas of Living Australia” (ALA), and “REDMAP”.

Sites added to the SoOE Map (Table A-3) comprised a broad range of subject matter, mostly from my local area and personal experience, including revegetation projects, sightings of native

¹⁶ <https://stateofourevironment.wikispaces.com/The+Geospatial+Web+2.0%2C+PPGIS+and+VGI>

¹⁷ <http://stateofourevironment.wikispaces.com/Environmental+GeoWeb+2.0+Portals+and+Platforms>

animals, my perspective on significant trees, observations of potential water issues, information relating to fire and heritage management, and a producer of dairy products I purchased. The site “Natone Hill Fire Management Plan” demonstrated how a local management authority could make the plan more accessible to its stakeholders. I aimed to show a broad range of possible entries without an emphasis on what, how, or a defined structure. In this cycle three sites, 17, 20 and 26 were added by other participants, described in more detail in 4.2.2.

The most significant occurrence during this stage came when I investigated how to add the capability for users to contribute to the quality assurance of information, with an addition to Google Places on 24 May 2011 regarding Ashgrove cheese. In the comments, the URL for the SoOE Wiki was added. I also provided feedback to Google regarding duplication of the entry, how the position of the pre-existing entry was wrong, the difference in naming of the same business and the potential issues posed by these uncertainties. When I checked later that month the duplicate had been removed, demonstrating a prompt response to volunteered feedback. The possible effect of this action on participation was surprising. It is discussed below in section 4.2.2. Although not apparent at the time, the next most significant activity related to observations (19, 23, 29) regarding either a stormwater discharge that was a potential pollution source or wastage of water. These initial observations catalysed a series of ongoing observations and deliberations over the next 6 months, addressing how GeoWeb 2.0 could be used to take the next step beyond sharing information to solving issues.

Technical issues forced a re-examination of claims to ease of use. The table of contents in the SoOE Map quickly became too large to be easily viewed on one screen as a simple list of items. All that was possible was to reorder items in the list. This limitation was made particularly acute after Pierre uploaded an extensive dataset. Finding and viewing items required scrolling through the whole list, with no search option available and no capability to group items, such as into layers as provided in desktop GIS. We discussed the issue and Pierre agreed to remove the dataset. One solution would have been to create separate maps for different subject matter areas. For example, there could be one for significant trees, another for fauna sightings and another for weeds. The problem then becomes examining the relationship between the information shown in these different maps.

Another limitation was the default icons supplied for representing sites in the map. One participant, Louie, commented that the symbol used to represent the Natone Hill fire management plan looked more like a volcano. Another commented on the relationship between

the size of the icon, the ability to be noticed and hence the propensity to contribute. This highlighted how different representations can confer power and affect the motivation to participate. I began investigating how to improve the icons in the map, the results of this are described in PAR 4 (Section 5.1.1). The technical limitations of the SoOE Map quickly became apparent. I then agree with the findings of Beaudreau et al. (2011) who found that ease of use was gained at the cost of added functionality.

4.2.2 Online participation

During PAR 2 I did not send out any more direct invitations to potential participants from either the Wiki or the Map. In the update report, I had written that non-collaborators could request by email to participate. No one requested to collaborate in this way. The web address was referred to people I met and who had indicated an interest in the research, but none made a request to register and collaborate online. Offline comments provided by unregistered participants did, however, show they had looked at the online sites.

In an offline conversation Anneka described how large old Eucalyptus trees near a bus stop were very special. This was prompted by my addition of significant trees to the SoOE Map. After my encouragement, Anneka added trees she found significant to the SoOE Map, describing them as Sentinels of Bus Stop 68 (Figure 4-15). Anneka was also interested in how she could use such a capability for a bushwalking club. This demonstrated an interest, increased understanding and ability, and a significant change particularly for someone who had no technical or professional background in environmental management or GIS. In contrast, this person's friend commented that they had read everything I had written and still could not understand what "I was going on about". This latter comment and similar comments from Toby and Barry prompted ongoing reflections on how well the research was communicated and subject matter understood. Pierre also provided different views of the maps as shown with the extra links on the wiki Map page.¹⁸

¹⁸ <https://stateofoureenvironment.wikispaces.com/Map>

Figure 4-15: SoOE Map site “Sentinels of bus stop 68”

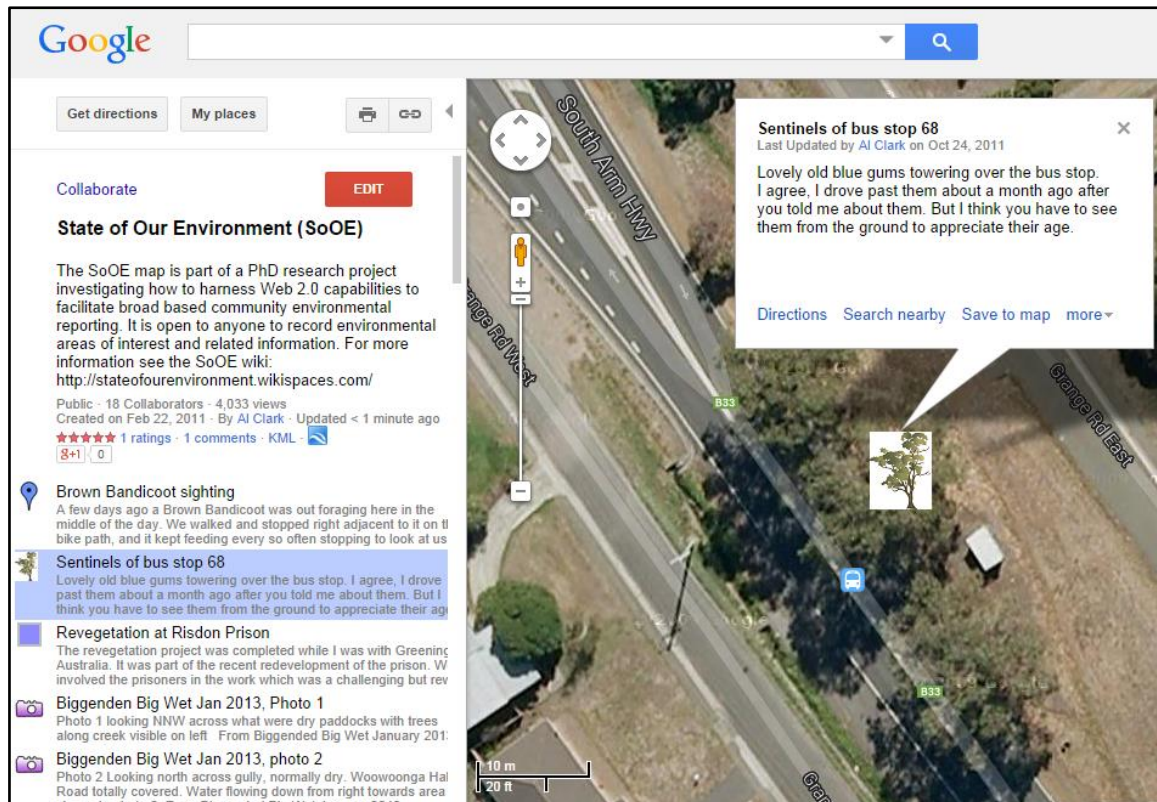


Figure 4-16 shows the visits logged per day by the SoOE wiki during PAR 1 and 2. The most interesting occurrence is the large number of visits on 25 April 2011 of just over 250. This was immediately following my addition to Google Places¹⁹ on 24 May 2011 of comments regarding Ashgrove cheese. Most visits were to the page “The Geospatial Web 2.0, PPGIS and VGI” (Figure 4-17). The vertical axis shows the number of views and the horizontal access shows to which page the visits occurred. The coloured bars correspond to one of four time frames the statistics were sampled. The oldest pages have views for all four dates, while the pages that were most recently added have only one view. It clearly shows to which pages’ visitors are drawn. The difference between the high number of page visits and the low number of unique visitors is interesting. This correlates with the addition to Google Places²⁰ on 24 May 2011 of the site for Ashgrove cheese and my reporting of the inaccurate location to Google. It is possible this action stimulated interest from Google employees, who would also have had an

¹⁹

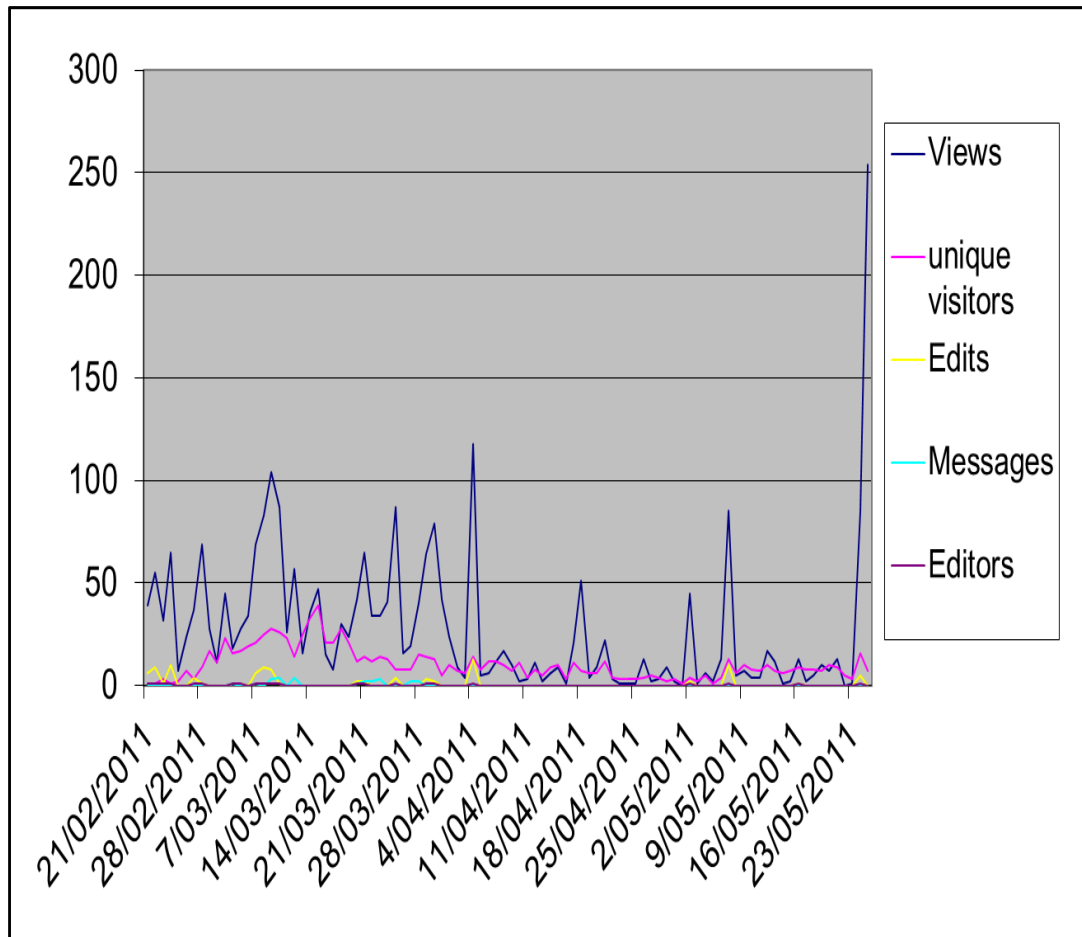
<http://maps.google.com.au/maps/ms?hl=en&ie=UTF8&msa=0&msid=217568692591192122146.00049ce5c93a2be068ad3&ll=-41.631867,146.282959&spn=4.351873,7.064209&t=h&z=7>

²⁰

<http://maps.google.com.au/maps/ms?hl=en&ie=UTF8&msa=0&msid=217568692591192122146.00049ce5c93a2be068ad3&ll=-41.631867,146.282959&spn=4.351873,7.064209&t=h&z=7>

interest in the subject matter. It may also account for the difference between views and unique visitors as, if all or many of the visitors originated from Google, they may have been recorded as originating from one source.

Figure 4-16: Statistics collected by the SoOE Wiki up until 25 May 2011

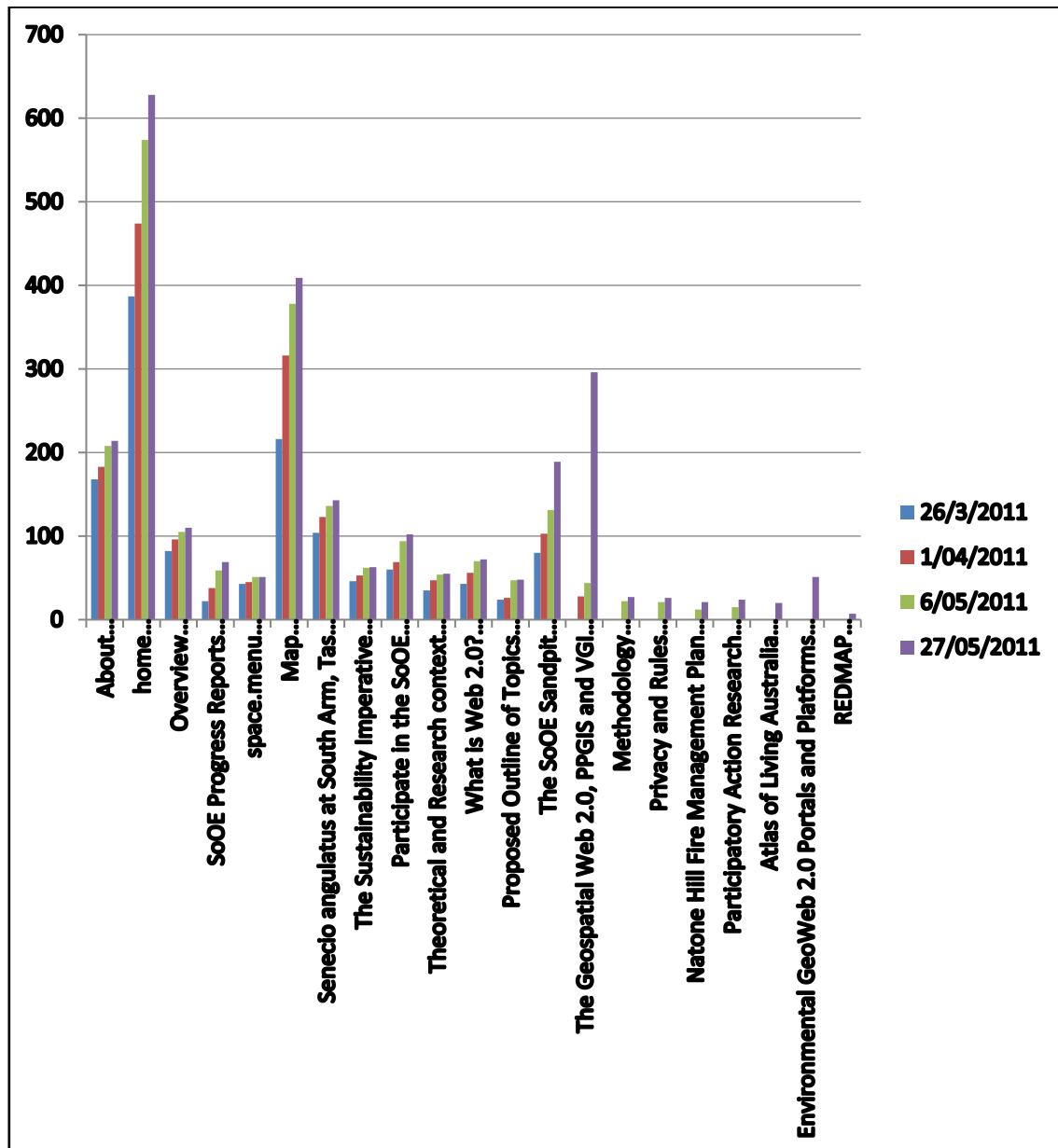


This demonstrates how visits can be increased by linking to other well-used platforms in such a way that prompts visits. Creating such links increases a site's presence on the internet and its integration into different networks (Anderson 2012) increasing a publisher's ability to reach wider audiences. This has an amplifying effect, as search engines and other recommendation software interpret interest in a web resource as an indicator of its relevance, placing it higher in the order of search results and recommendations (Anderson 2012).

This feature of the internet contributed to the echo chamber effect (Davidow 2011), where popular or dominant voices are further magnified. Macnamara (2010) points out that as Web 2.0 has allowed more people to publish the problem then becomes getting attention, or as

Macnamara (2011) puts it, making an audience. These insights all point to how individuals can increase visits to their online publications, be heard and develop an audience.

Figure 4-17: Summary of visits to each Wiki page for selected dates



I began, however, to have some reservations about the reliability of the Wiki statistics, mainly due to the recording on some days of more unique visitors than there had been page views as highlighted in Table 4-2. The organisers of Wikispaces did not supply a completely satisfactory answer to how there could be more unique visitors than total visitors. This raises questions about what Wikispaces is measuring and what a page view means. It may represent every refresh of a page and not the number of times a page is read. The provider did not elaborate on

these issues and this highlights the difference between what Wikispaces purports to provide, the ability to understand audiences, and the actuality.

The number of countries from which wiki visitors originated continued to grow through PAR 2. The percentage of visits from each country is shown in Table 4-3. This confirms the power of the internet to reach a global audience. I had no feedback from any of these international visitors, and no knowledge of who they are and why they visited the SoOE. I installed Google analytics (Google 2011a) to answer some of these questions and address issues regarding page view measure, but a referral site blocked its functioning.

Table 4-2: Wiki statistics with instances of unique visitors greater than views highlighted

Table - Wiki Visitors as recorded by wikispaces						
Stage	Date	Views	Unique visitors	Edits	Messages	Editors
1.1	8-Mar-11	83	25	9	0	1
1.1	9-Mar-11	104	28	8	3	1
1.1	10-Mar-11	87	26	1	4	1
1.1	11-Mar-11	26	23	0	0	0
1.1	12-Mar-11	57	14	0	4	0
1.1	13-Mar-11	16	25	0	0	0
1.1	14-Mar-11	36	33	0	0	0
1.1	15-Mar-11	47	39	0	0	0
1.1	16-Mar-11	15	21	0	0	0
1.1	17-Mar-11	8	21	0	0	0
1.1	18-Mar-11	30	28	0	0	0
1.1	19-Mar-11	24	21	0	0	0
1.1	20-Mar-11	42	12	2	1	1
1.1	21-Mar-11	65	14	2	2	1
1.2	22-Mar-11	34	12	0	2	0

For the SoOE Map, there had been over 2100 views and 13 participants had registered as collaborators. It was the area of the SoOE attracting the most visits, with the wiki only attracting just over 600 visits in the same time. This concurs with the wider trend observed by Batty et al. (2010) that from 2005-2010 Google Trends shows searches for the term “maps” increasing by 200%. In PAR 1, only I added information to the SoOE Map. In PAR 2 there were additions by two other collaborators.

Table 4-3: Visitors to the SoOE Wiki by country of origin

Country of origin	% up to 27/05/2011
Australia	84.80%
United States	14.70%
Singapore	0.20%
India	0.20%
Great Britain	0.10%
Russian Federation	0.03%
Ukraine	0.02%
Taiwan	0.02%
TOTAL	100%

4.2.3 Offline participation

Throughout the research I discovered and was referred by participants to other Web 2.0 applications and platforms addressing environmental subjects. Significant applications included the Atlas of Living Australia (Australia 2011a), RedMap (IMAS 2010), Birdata (BirdLife Australia 2014), and wePlan (Parks Victoria 2011). Where possible I registered on these platforms to assess their implications for this research. From these platforms I began to receive regular newsletters and other emails.

The ALA (Australia 2011a) is a major Australian Government initiative harnessing GeoWeb 2.0 capabilities to enlist the community in documenting the nature and occurrence of Australia's biodiversity. The ALA provides a rich user experience, where maps of species occurrences can be custom generated, and there is easy access to much of the related attribute information. Two-way interactivity is provided by allowing volunteers to contribute sighting data and photos, transcribe specimen labels, collaborate in citizen science projects, and contribute to software development. The ALA also demonstrates openness by providing easy access to information and resources for free, using creative commons licensing, and employing open source software. Launched in Tasmania in 2009, the Institute of Marine and Antarctic Studies is using GeoWeb 2.0 platform, RedMap, to gather information from the community on the movement of fish species. Significant interactions with RedMap occurred in subsequent PAR cycles.

The information volunteered by participants demonstrated their understanding of the emerging technology, applications, and thoughts about the research. The referral to the website FeralScan

(IACRC 2011a) from Barry, an older land management professional, was despite his level of understanding. Barry communicated to me that “I was losing him” when I mentioned that such environmental initiatives emerged out of Web 2.0, referring to the popular web services of YouTube and Flickr as examples. This participant also said the purpose of the SoOE was not clear, that it appeared to be aimed at bypassing traditional government controls and, if so, expressing that more clearly would engender greater participation. I was reluctant to position the research as so overtly political.

Simon’s referral to a report on GeoWeb 2.0 use in emergencies (Harvard Humanitarian Initiative 2011), indicated a deepening understanding of potential applications. In PAR 1, Simon had expressed scepticism about the usefulness of such practices. Participant Harry referred to the Open Conservation Standards and from this I discovered and reviewed OSGeo, for developing open geospatial standards. Another meeting discussed potential collaborations on more focussed projects, one of which was developed further in stage two. Participant Connor offered to host the SoOE web applications on their personal site. This was not pursued due to ownership and transparency implications and how this might affect participation.

4.2.4 Reflections on participation

Throughout PAR 1 and 2, I reflected on the rates of participation and the reasons for collaboration. I was concerned about the possibility that the lack of “polish” resulting from the stance of “worse is better” may have inhibited participation. Due to the limited ability to record what map information was viewed, I focussed on the Wiki usage and participation rates.

Approximately 50% of invitees joined, 10% participated and 5% made edits or added information. For Wikipedia, the founder Jimmy Wales estimated 50% of edits are made by less than 1 per cent of users (Tapscott & Williams 2008). Wikipedia’s (2015) page on Wikipedians states that only a minority of users edit regularly. Wikimedia (2009) states that for larger Wikipedias, active or very active contributors make up only 0.02-0.03 per cent of all visitors. Tancer (2009) cites evidence indicating usage of Web 2.0 sites approximates a 1-9-90 distribution. Out of 100 visitors, 90 will view only, another 9 will make minor edits from time to time and only 1 makes a major contribution. Tancer (2009) discussed whether this distribution is influenced by ease of use of the technology. Easier to use sites have higher levels of active participation. Howe (2008), and Tapscott and Williams (2008), argue time is a major impediment and that successful participation is helped by breaking tasks down into manageable

chunks, typically something that can be achieved in around ten minutes. Shirky (2008, p.264) describes the requirements for online collaboration as a Promise (shared vision), Tools (software/applications/platforms), and a Bargain (rules for behaviour).

Research into crowdsourcing in the businesses iStockphoto.com and Threadless.com (Brabham 2008, 2010) found participants were motivated most by the desire to make money, develop individual and creative skills, to have fun, for freelance work, and love of the respective communities. Budhathoki (2010) described the most significant motivator for participants to contribute to OpenStreetMap as an individual's local knowledge about geospatial situations. As well as the role of this "instrumentality of local knowledge", self-view and monetary reasons were strong motivators. While it is debateable how transferable these results are to environmental sustainability applications devoid of profit making potential, Brabham (2009) also posited crowdsourcing as a means of enabling citizen participation in public planning projects. The motivations for participation in a crowdsourcing application to improve public engagement in transit planning included opportunities for career advancement, to have fun, for personal expression and peer recognition, to contribute to a collaborative effort and to learn new skills and knowledge (Brabham 2012).

Participant Connor referred to a blog by Seth Godin (2011) whose theory is that the ability to participate in this way is completely new to most of us and we are not yet comfortable doing so. Godin writes that people still need someone to "say go", as we are not used to the ability to publish online, and that the lack of contribution is due to this form of cultural inertia. Prevalent in the media at the time were concerns regarding negative practices associated with the internet, such as cyber bullying and stalking, trolling, and identity theft. These and other concerns are addressed by many authors (Carr 2008; Davidow 2011; Keen 2008; Morozov 2011; Rabaul 2011; Sui 2011). Hence, issues of privacy, confidentiality and security were also relevant to participation.

Most online participation was viewing of the site and map, with feedback either through personal conversations or via email, despite the capability to place feedback and comments directly onto the wiki and map, and to amend or create content. People expressed a reluctance to provide comments to potentially a global audience. Learning how to add comments or content constituted another barrier, particularly in the context of other life demands. Scepticism was expressed about the value of GeoWeb 2.0 and the lack of clarity about the purpose of the SoOE.

The experience with the SoOE to date demonstrated the difficulty of getting participants to actively and overtly direct the research through such a mediated context. For this reason, I kept receiving information via personal communications or email, and offered to provide advice on how to interact directly if required. There were no direct statements from participants regarding the research directions and priorities. In this absence of explicit direction, I interpreted what people said and shared as an indication of their interests in this respect.

That much of the interaction occurred offline, suggests gaining co-direction by participants requires more direct personal contact. An important point that I develop in later reflections regarding my deepening understanding of PAR, was how long it takes to negotiate equality of participation. This aim of PAR is different to the Web 2.0 idea of “engage and co-create”, the latter of which is to encourage participation for commercial benefit and not for equality in direction. Attention to these power dynamics in relationships constitutes an important choice point and measure of relational quality in PAR.

4.3 PAR 3: Emerging technical limits

PAR cycle 3 occurred from 6 June 2011 through to 19 August 2011. This finished with the distribution of update report number three and was covered by my journal pages 80-118.

4.3.1 My Online Participation

Only one extra page was created on the SoOE wiki. It was that named “Water” (Figure A-4) and described my experiences with the water leak first detected during PAR 2. Two additional locations relating to the water leak were added to the SoOE Map (Table A-4, sites 31 and 33). The logging of Site 31 (Figure 4-18) was conducted using a hand-held GPS to confirm the location of the drain outlet. Before this I had estimated the position from the surrounding features, a process facilitated by the satellite imagery. Site 33, on the corner of Milford and Lincoln streets (Figure 4-19), was added as part of the process of deciding if the water was associated with a pollution discharge. The origin may have been a vehicle wash-down station opposite the intersection of Bay Road with the East Derwent Highway. However, by listening at the stormwater inlets on the roadside I could track the water back to Site 33. As this location was higher than the vehicle wash down location, the wash down could not have been the origin. By continued observations I also confirmed that the water discharge was ongoing and consistently clean, even during dry periods when the flow should have been lower.

Three files other than the update report were attached to the wiki. The first contained a presentation to the annual University of Tasmania School of Geography and Environmental Studies (SGES) conference (now School of Land and Food). The second was a KMZ file containing the SoOE Map in a format that could be opened in Google Earth. The last was a pdf file of a document describing sea level rise. The locations of the SGES presentation and that of the document about sea level rise were added to the SoOE Map (sites 34 and 32 respectively) and hyperlinked to the wiki pages. The SGES presentation was an introduction to my research and was intended to provide transparency as well as a demonstration of other forms of information sharing.

Figure 4-18: SoOE Map Site 31, location of drain on Lindisfarne Bay

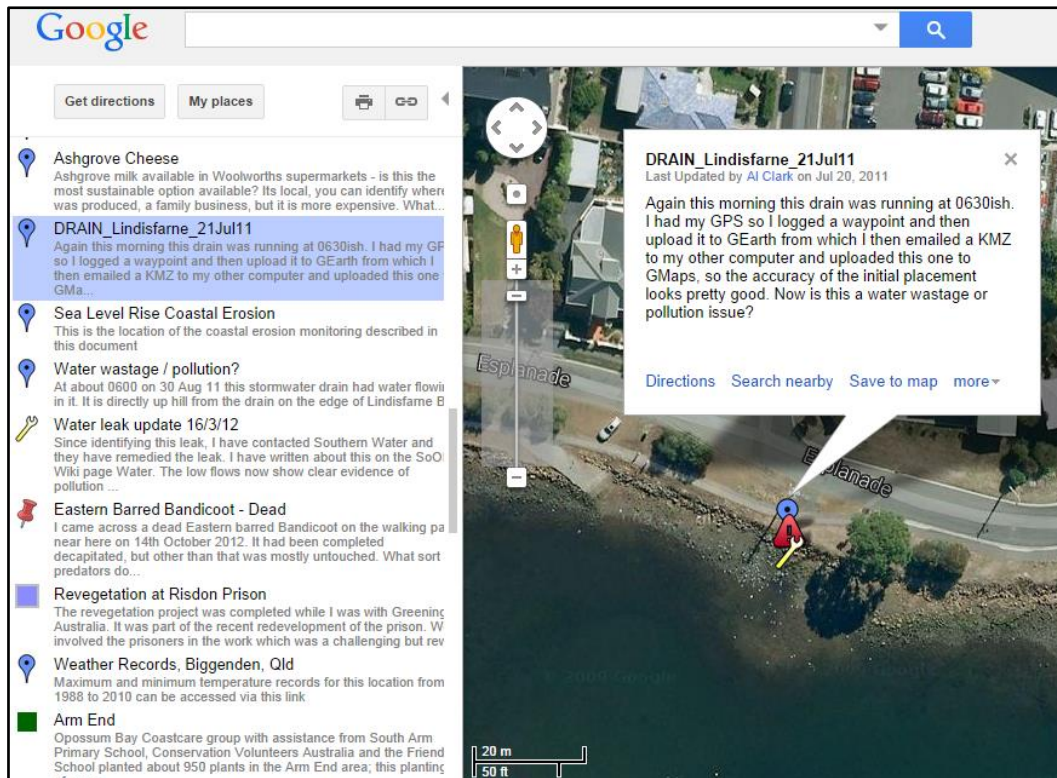
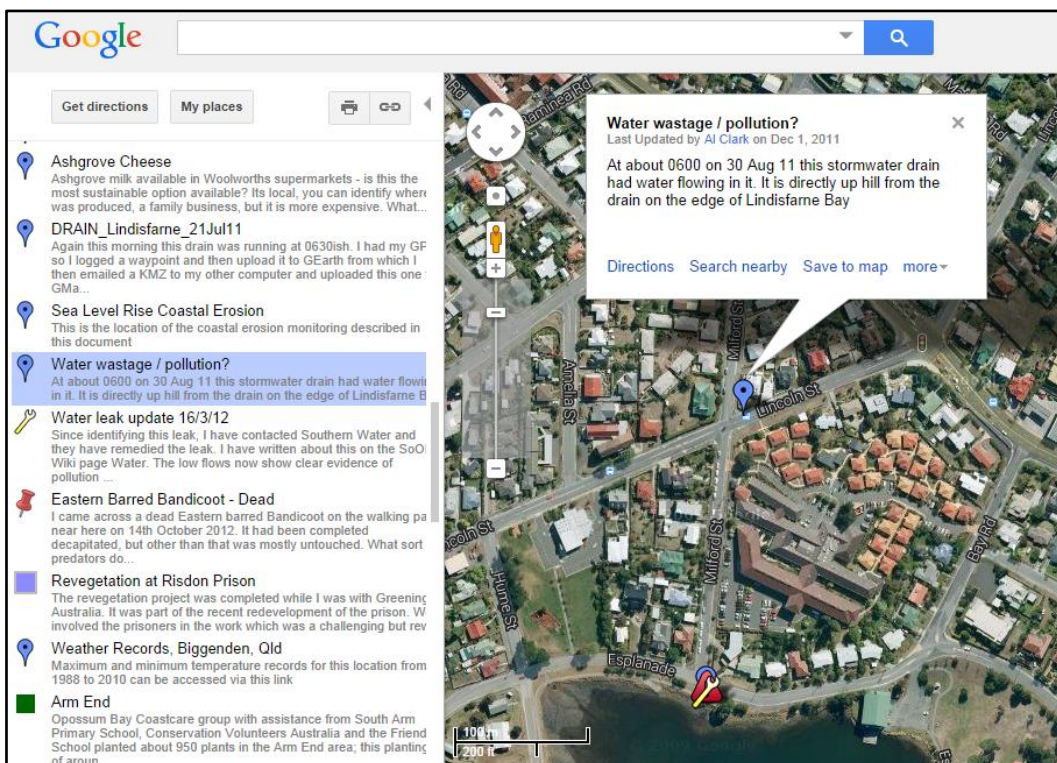
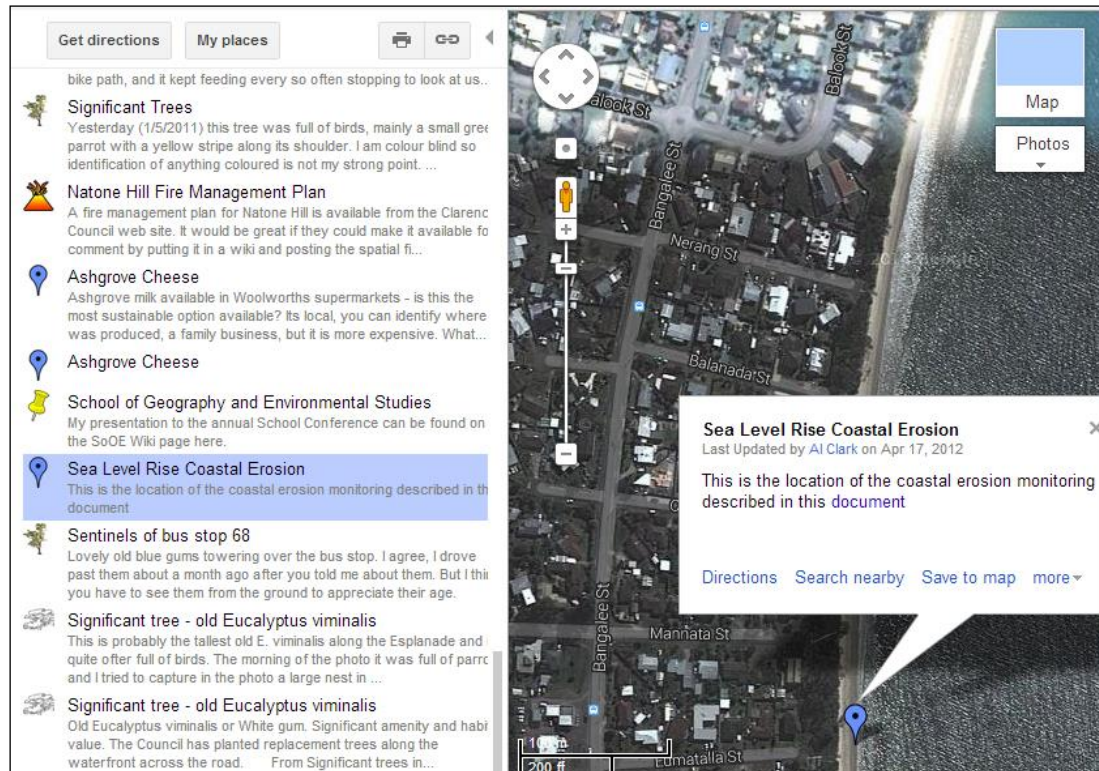


Figure 4-19: SoOE Map site 33, location uphill of discharge point also with consistent water flows



The sea level rise document shows how reports could be linked to the location and was incorporated to broaden the focus geographically and in subject matter. (Figure 4-20). The document on the SoOE Wiki could be opened via the map dialogue box (Figure 4-21).

Figure 4-20: Demonstration of how to link to a document from SoOE Map



The capture of the location of site 31 with a GPS and its translation into the KMZ file involved a series of offline experiments with different FGW2S for translating file formats. The GPS I used, a handheld Garmin Etrex, did not capture the location in the KMZ format used by Google. My journal records several days trialling different applications including GPS Utility, GPS Babel, DNR Garmin, and Basecamp, to translate file formats (Figure A-5), and the frustration of getting this to work. This part was not easy and beyond a casual user at the time. It shows the importance of standards and interoperability in facilitating easy use. I later came to use a smart phone with the application GPS Essentials, (referred by Connor) that made this much easier. Hence access to the appropriate resources is crucial.

Figure 4-21: Sea Level Rise Coastal Erosion document opened using hyperlink²¹

As the wiki became larger it became more complex and difficult to work in new material. I did not have the required organising principles or structure, only a collection of ideas that related to the overall concept, but with no clear idea of the relationships between the ideas yet apparent. I then began experimenting using blogs for partially worked ideas such as on the new KML button I describe in 4.2.3, and wrote the blog “New KML button on my SoOE My Map”.²²

4.3.2 Online participation

While names were omitted in the update reports to protect privacy, I was cognisant of giving due credit to contributors and not claim these for myself. Hence, participants were encouraged to make their contribution known and to claim ownership on the Wiki or Map. It was reiterated

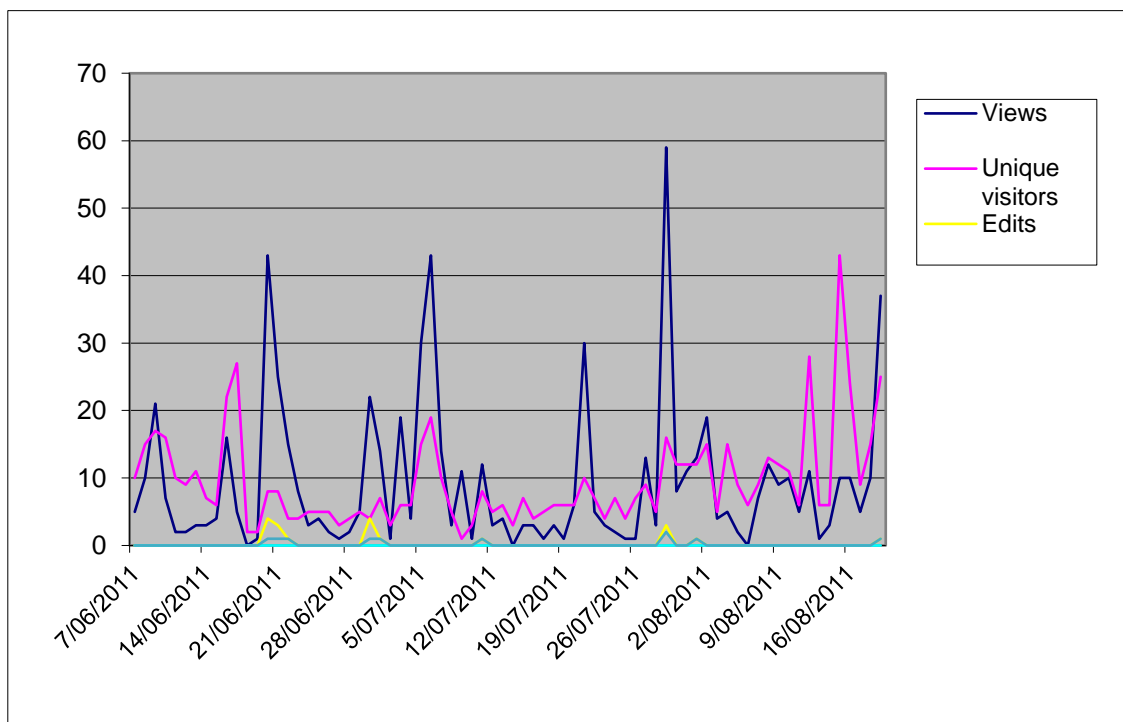
²¹

http://stateofourenvironment.wikispaces.com/file/view/HistoryOfRochesBeachTree_2001_2011.pdf/244403745/HistoryOfRochesBeachTree_2001_2011.pdf

²² <http://alisterclark.blogspot.com.au/2011/07/new-kml-button-on-my-sooe-my-map.html>

that anyone could become a collaborator by an email request. The invitation to participate was extended to others who had been emailed the reports. None did so in this way. The intention was to keep trying to make it easy for people to become collaborators. The update report distribution lists contained more people receiving reports than registered as collaborators. A brief overview of the statistics was included in update report three, as well as the link to the online version. The usage statistics for PAR 3 (Figure 4-22) show visitors continued to view the SoOE wiki, with particularly high numbers on 20 June (43), 6 July (43) and 29 July (59).

Figure 4-22: SoOE Wiki usage statistics for PAR 3



On these dates except 6 July, I was editing the wiki and hence my visits contribute to these numbers. On 7 July, I had circulated an email regarding attaching the SGES presentation to the SoOE Wiki. The wiki did not provide statistics relating to viewing of attached files, such as the presentation.

Of continuing concern were the anomalies in the data provided by Wikispaces, where the number of unique views exceeded the number of views. This is particularly noticeable on 15 August 2011 when the number of unique views was 43 and the number of views only 10. The Wikispace reply to my queries was that there was a delay between these two data sources. That would suggest the two should correspond by moving one data source either left or right on the x axis. It is possible to appraise visually that moving either data source would not address the

issue. These issues together with the possibility that the numbers of visits and views included search engines and other automated visitors, as indicated in the message on the wiki statistics page (Figure 4-23), made me increasingly wary of making interpretive statements regarding their meaning.

Figure 4-23: SoOE Wiki notice regarding visitors including search engines and “other crawlers”

All dates are in GMT. Statistics are updated daily by 12:00 PM (noon) GMT. View, visitor, and country graphs are available beginning October 2005.

Visitors are counted as unique IP addresses in a given day, including search engines and other crawlers. Note that for private wikis, we count views and visits to the access denied page ("You've Reached a Private Wiki") by search engines and other guests, so these numbers may be slightly higher than you expect.

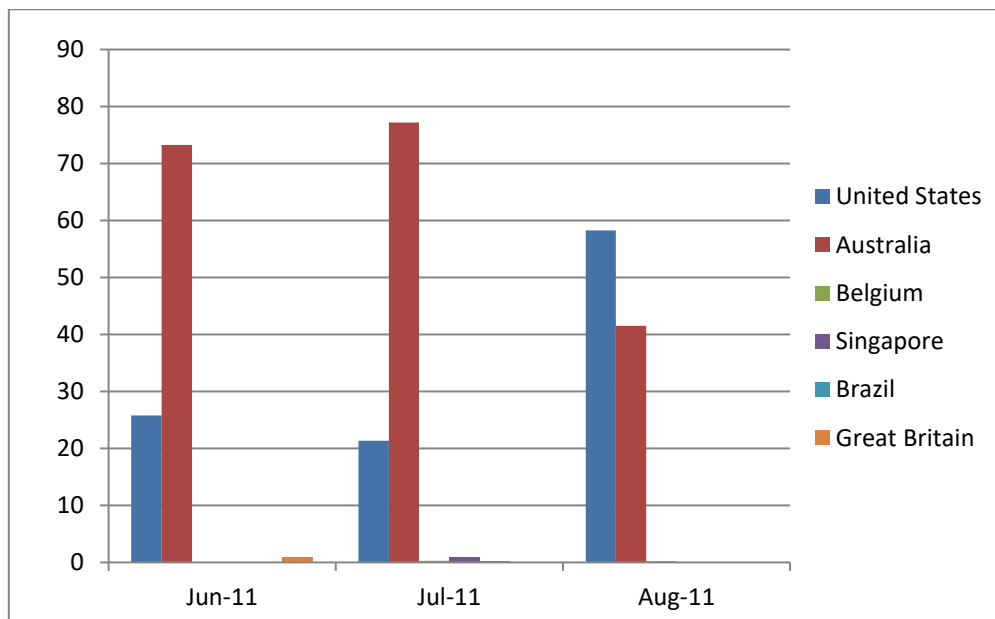
It was also not possible to determine who was viewing which parts of the wiki and for how long. Google MyMaps also did not provide any record of who had been invited to collaborate, who viewed the Map and which aspects. After attempting to get Google analytics working to provide additional usage information, I began making enquiries regarding courses in online Quantitative Research Methods to develop skills to address these problems.

The rate of viewing decreased which was unsurprising as I had invited only 3 new participants during this cycle, of which only two registered online. I also had not added much new information. My reluctance to invite more participants was mainly due to the technical issues with adding and organising more information that more participants would create or demand. The decline in visitation rates suggests they relate to activities such as inviting people and adding new material. This idea is captured for blogs by Anderson (2012):

Each blog is like a fireplace, and each blog post is like a log heaved on top to keep the fire burning ... As long as a blog puts out heat and light, others who care about the author's subject are drawn to it (Doc Searl and David Sifry, 2003, Webpage. quoted in Anderson 2012: p. 99).

Most visitors during this cycle were from Australia and the United States, with those from the US concentrated in August (Figure 4-24). Other visitors were from Belgium, Singapore, Brazil and Great Britain and the pattern of viewing has distinct regional and temporal variations. More information on these visitors might provide insights into how to reach overseas audiences.

Figure 4-24: Percentage of visitors to the SoOE wiki by country of origin for the months of June, July and August 2011



4.3.3 Offline participation

To try to find a solution to the problem with the Table of Contents (TOC) introduced in PAR 2 (4.3.1), I had a working meeting with one participant. During this meeting, Pierre demonstrated how to organise data in the SoOE Map by viewing it in Google Earth, and then organising it into layers. It was also possible to view separate maps together in Google Earth, a type of “mash-up” that can be created without programming. While this option provided an effective solution to the TOC problem, the collaboration ability was lost with the data stored on each computer, not in the cloud. It was possible to upload a copy of these data to a cloud storage location, and as an example the KMZ file was attached to the SoOE Wiki. However, this created the additional need for all prospective users to have Google Earth installed. The file could be loaded back into another MyMap, but the layers were once again lost. Also, version management problems arise when the data are downloaded and then changed by different collaborators. I did not find a satisfactory solution to this problem and it forestalled further populating the map with examples.

Concerns regarding the security and reliability of using only cloud based storage for volunteered information required saving a local back up copy of the information in each platform. In a meeting, considerable time was spent on how to download data from the SoOE

MyMap. I was in the process of writing up how to do this, when a new button appeared in the legend of the SoOE Map labelled “KML” (Figure 4-25).

Figure 4-25: KML button in Google MyMaps that allows data from the map to be downloaded to the local computer



By clicking on this button, the map data were downloaded in a KML file onto a local computer, a very simple way to backup the source information. At the time, I thought it addressed one of the perceived risks of relying on cloud storage alone. However, on closer inspection, the file did not include all the data or metadata. Importantly it did not include the time each file was created, and Google Maps did not make this easy to get. Anderson (2012) cites data portability as one of the main issues with Web 2.0 services, where data are increasingly fragmented across multiple databases.

The appearance of the KML button is a powerful illustration of the pace of change in the internet and the necessity of finding ways to work with this change. It raises questions regarding to what degree time and effort should be invested in developing solutions, such as the working meeting described above, when they can potentially become redundant. For example, in a later release of Google Maps Engine Lite, the capability to group data into layers was provided. Yet later, Google notified (17/9/14) that MyMaps was being upgraded to also include layers. This was, however, provided at the expense of other functionality such as the ability to add photographs, and loss of the KML button. Time and effort invested can thus be lost because of external factors.

An interesting comment came from a PPGIS researcher who supplied a reference to the Landscape Values and PPGIS Institute (Brown 2011). It was of a disinterest in two-way information interchange, only in using the technology to gather information. Their research was an excellent Australian demonstration of the use of interactive online maps in landscape planning and, while this application was using a GeoWeb 2.0 service, Google Maps, it was only used for one way information transfer.

Also conflated with PPGIS at the time in my online writing was Goodchild's (2007a) concept of volunteered geographic information (VGI). Interestingly no comments were received either online or offline regarding this, despite the relevant wiki page attracting considerable interest (Figure 4-17). If not simply an indication of disinterest, an alternative interpretation is that of a low awareness of these distinctions. While McDougall (2009) claimed that PGIS is more mediated or controlled than VGI, Brown and Kytta's (2014) later attempt to clarify the distinctions between PPGIS, PGIS and VGI, add weight to the latter assessment. This prompted thinking about how GeoWeb 2.0 might be conceptualised, used and researched using different terminology. It constituted a choice or bifurcation point in the research based on what I thought worthwhile pursuing (Phelps & Graham 2010; Phelps & Hase 2005).

4.3.4 Reflections: openness, leading and the GeoWeb

In update report three, I quoted the following paragraph as capturing the overall intent of the research:

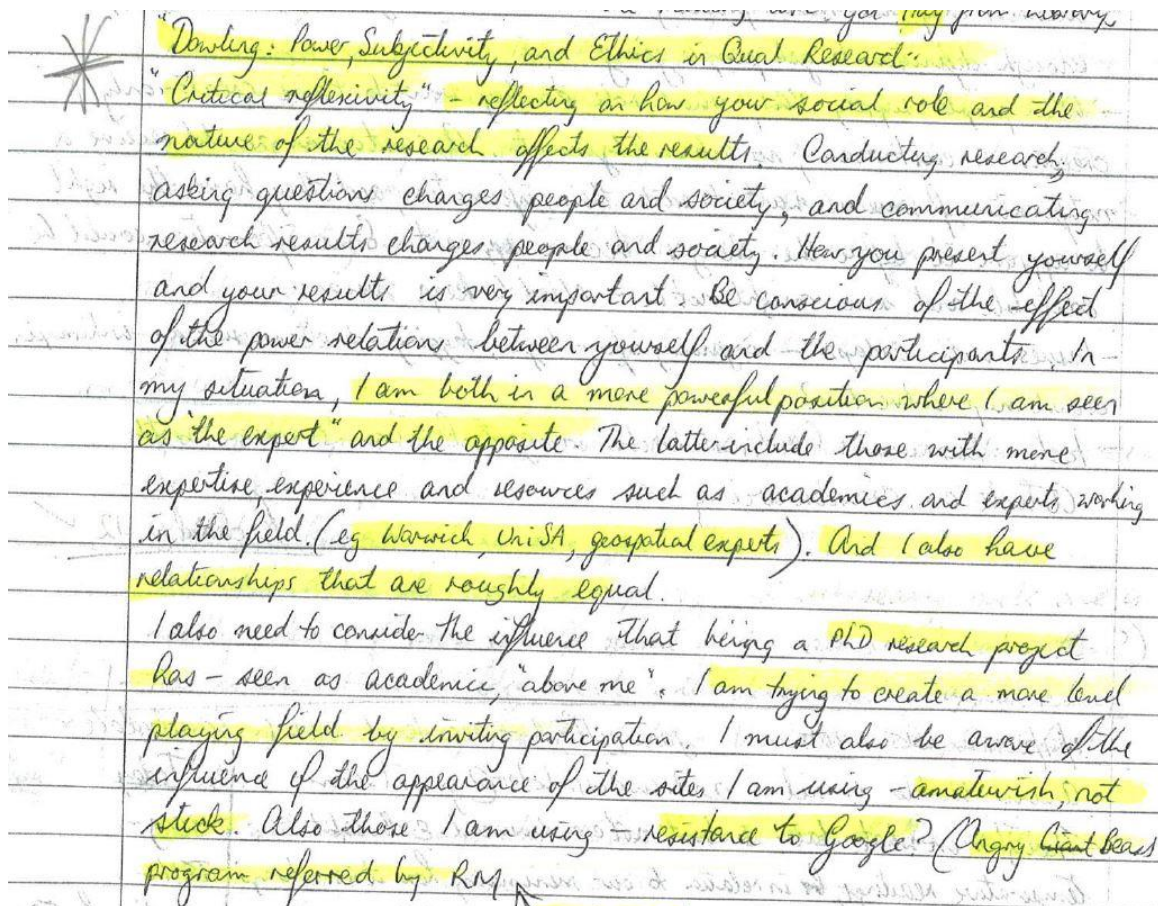
... consider research that explores realities not yet in existence. Investigators join in generating virtual worlds ... in which people may participate. Through their participation they learn of the potentials of such worlds, and such knowledge can be used to refashion existing institutions (Gergen & Gergen 2000, p.19).

I thought that not only could existing institutions be refashioned but also new institutions or ways of being, be created. The intent of expressing this to participants was to communicate the generative possibilities of the research to follow what they chose to create. It is an example of my early positive stance and attempts at openness. My journal contains several entries in which I reflected upon my position within the research, subjectivity and power relationships following the advice of Dowling (2010), for example Figure 4-26.

Trying not to lead participants was important to normalise power relationships, for ethical reasons, and to maintain openness. For example, I did not want to advocate for particular applications, or my use of the SoOE applications to be seen as a de facto recommendation of these. The repeated referral to openness as a defining characteristic of GeoWeb 2.0 (Anderson 2007; De Longueville 2010; O'Reilly 2005) suggested that requiring volunteered information to conform to a particular standard or classification system was unnecessary and could inhibit participation. Therefore, an emphasis on openness remained an important goal of the SoOE. The experience, described in 4.2.3, of how visitation rates appeared to align with my activities suggested this goal may not be achievable. Kemmis and McTaggart (2005) discuss this in their

reassessment of the concept of the researcher in PAR as a disinterested facilitator; their influence on participation, a position of power, is essentially inescapable.

Figure 4-26: Research journal page 96, 7 July 2011



"Dowling: Power, Subjectivity, and Ethics in Qual. Research."
 "Critical reflexivity" - reflecting on how your social role and the nature of the research affects the results. Conducting research, asking questions changes people and society, and communicating research results changes people and society. How you present yourself and your results is very important. Be conscious of the effect of the power relation between yourself and the participants. In my situation, I am both in a more powerful position where I am seen as "the expert" and the opposite. The latter include those with more expertise, experience and resources such as academics and experts working in the field (eg Warwick, UniSA, geospatial experts). And I also have relationships that are roughly equal.
 I also need to consider the influence that being a PhD research project has - seen as academic, "above me". I am trying to create a more level playing field by inviting participation. I must also be aware of the influence of the appearance of the sites I am using - amateurish; not slick. Also those I am using - resistance to Google? (Angry Giant Bears program referred by RM)

The concept of openness was also influential in my assessment of other platforms such as RedMap, drawing strident questioning of my perception of openness (21/12/11). I began, however, to suspect that the objective of the SoOE was too broadly focussed. Shirky (2008, 2010) maintained that crowdsourcing projects needed to be focussed enough to appear achievable to participants. The direct relevance to participants' lives of collecting information for State of Environment reporting was difficult to establish, as its purpose was more strategic. This was later confirmed by offline feedback. In my journal I noted a shift from trying to create a SoOE, to demonstrating the concept of community-based information sharing.

A professional GIS magazine article (Young 2011) described the emerging crowdsourcing of geographic information in Australia and concluded that regardless of political restraints and public sector conservatism its expansion was inevitable. The article missed the importance of

Neogeography, the power of GeoWeb 2.0 to allow creations such as the SoOE. Such creations may be simple now but developments would progress to provide increasing ability such that *“the community do more than volunteer GI they volunteer GIS”* (AC journal p. 99.3, 13/7/12). This viewpoint was to be tempered by later experience and learning. The intimations of this can be seen in the technical difficulties that began to be experienced, showing that not all GeoWeb 2.0 applications were easy to use. At the time these were interpreted only as personal limitations. In hindsight, it is possible to see more clearly how these emerging technical difficulties, together with the conundrums involved in not trying to over-influence participants led to a reluctance to encourage or catalyse further online participant action. At this stage I can identify a shifting in methodological focus from PAR to more AR, and in which auto-ethnography becomes relatively more important.

4.4 Summary

The first three PAR cycles addressed research objective 2 and 3, investigating the potential of free GeoWeb 2.0 services (FGW2S), for community-based sharing of environmental information and, in the process, also revealing factors influencing participation. The FGW2S used were free and easy to use to publish a variety of information immediately and widely, and supported the online collaboration of research participants. The incorporation of broad subject matter, different representations and information from multiple participants, demonstrated the ability of the FGW2S to allow individuals to unilaterally and collectively publish a broad range of environmental information. The spatial capabilities of the SoOE Map facilitated my developing understanding of the nature of a municipal water leak. The potential risks of vandalism from sharing information on indigenous heritage sites highlighted how complete openness is not always appropriate. Technical difficulties were encountered with the FGW2S that tempered the perspective they are necessarily easy to use. The technical difficulties arose partly as more information was incorporated.

Other existing applications of GeoWeb 2.0 for participatory environmental information sharing were identified and described. These applications incorporated aspects such as easy free access to information and resources, two-way interactivity, creative commons licensing, and open source software. As I described my unfolding understanding of GeoWeb 2.0 the diversity of terminology and related potential for misunderstanding first became apparent.

Participants both embraced the potential use of GeoWeb 2.0 and doubted the relevance of such use, questioning the quality of information created. Through offline communication participants referred aspects of GeoWeb 2.0 they considered relevant, exposed their interests and level of understanding, and issues of importance affecting their participation. The nature of GeoWeb 2.0 and purpose of the SoOE was not clear to all participants. Working sessions conducted offline attempting to address technical issues highlighted the importance of offline collaboration.

Statistics collected by the SoOE Wiki and Map provided data on those viewing content. This numbered more than the registered participants, certain topics were favoured, and included international visitors. Visitation numbers continually increased, as did the number of countries from which these visitors originated, and varied across spatial and temporal dimensions. Patterns of online visitation appeared to correlate with my activities and were cause for reflection on the nature of openness, how I acted and the potential for unintended effects on participation. Maintaining participation appeared to be influenced by my continued activity and linking to other online applications.

However, the anomalies between views and unique viewers, and which visits were people and which were machines remained unresolved. The degree the statistics represented reliable “real” human interest was questionable, Tancer (2009) highlighted the ease of misinterpretation and I did not have the required specialist expertise for interpretation. Due to these issues I focussed increasingly on offline participation and qualitative methods, marking another bifurcation (Phelps & Graham 2010; Phelps & Hase 2005) point in my research.

These topics are relevant for environmental sustainability for, as Smith and Stirling (2010, p.1) point out, “questions over who governs, whose system framings count and whose sustainability gets prioritised are all pertinent to social-ecological systems research”. Tracking web participation can help determine the characteristics of audiences for environmental information shared online and to interpret their interests such that multiple perspectives can be incorporated. Doing so unequivocally requires, however, understanding of and expertise in web analytics a capability not available to the broader community. It relies therefore on the benefice of a technological elite.

Complexity theory was used as guidance for my role in the research, suggesting a limited role of encouraging desirable activity and discouraging undesirable activity, such as the exposure

of significant values. This would allow maximum potential for self-organisation to occur. Rates of online participation were broadly consistent with those reported for other Web 2.0 initiatives. Anomalies in the statistics, and the potential that visits included automated web agents or robots, contributed to a growing concern regarding interpretation.

Chapter 5 Wider participation and perspectives (late 2011)

The previous experiences provided contra-indications regarding the potential of free GeoWeb 2.0 services (FGW2S) for broad community-based sharing of environmental information, and if GeoWeb 2.0 will assist in the achievement of environmental sustainability. This chapter describes PAR cycles 4-6 that involved a widening focus beyond the local and SoOE context, and use of GeoWeb 2.0 by the broader community.

5.1 PAR 4: Challenging and changing worldviews

PAR cycle 4 covered the period 19 August through to 4 November 2011, 76 journal pages were written and the cycle ended with the distribution of update report four. Folksonomy was explored as an alternative model for structuring data and its role in providing contextual information provided by participants as data ‘prosumers’. Experience in different contexts and additional literature contributes to an expanding critical awareness.

5.1.1 My Online participation

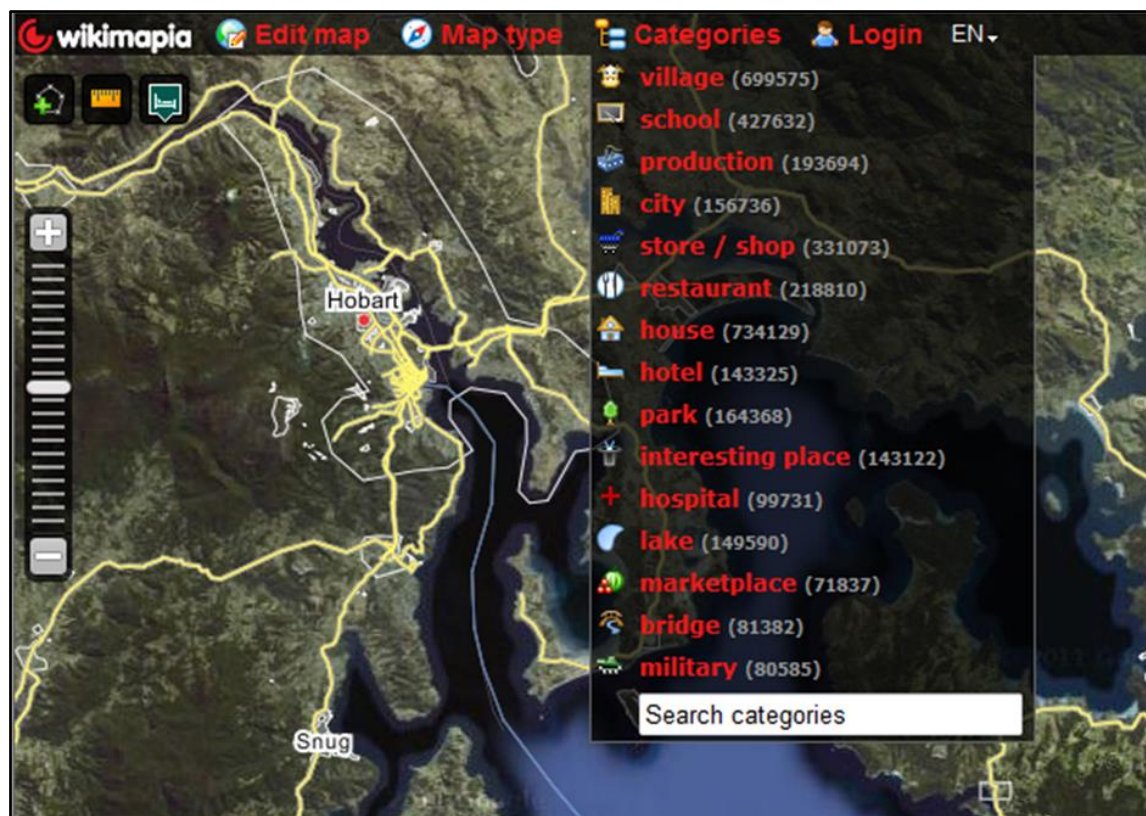
The SoOE wiki pages (Table A-1) and files (Table A-5) created during this cycle focussed on the different methods of organising information, taxonomy and folksonomy, efforts to create better icons for the SoOE Map, a poster presentation, and technology change. Taxonomy and folksonomy, and the work with icons, are discussed below and the technology change document under the sub-section headed *Reflections*.

Lau (2008, p.1) posited that “standardized classification inherently alludes to ideas of power in that certain ontologies are privileged over others” and argued for “folksonomies as equally valid systems for the organization of information”. Therefore, how information in the SoOE Map and Wiki should or could best be organised posed a fundamental ethical question regarding power relations between participants and myself. Who should decide upon the organising principles? Two approaches were explored in a presentation on 23 September 2011 entitled “Taxonomy or Folksonomy?”, and subsequently attached to SoOE Wiki.²³ Taxonomy is a “traditional” approach to classification for organising information

²³ <http://stateofourenvironment.wikispaces.com/Taxonomy+or+Folksonomy%3F>

particularly used in the natural sciences. Folksonomy is described as an outcome of the Web 2.0 practice of tagging and a bottom-up approach (Anderson 2012; Shirky 2005). Folksonomy offered an alternative method for definition of layers within the SoOE Map (Bishr & Kuhn 2007). Rather than layers assigned to a pre-defined classification system, the traditional approach in GIS, layers could be defined by user tagging. The way information is grouped can then reflect the conceptualisation of the producer of that information. User tagging as a basis for layer definition was provided at the time in GeoWeb 2.0 platform Wikimapia (2011) (Figure 5-1).

Figure 5-1: Wikimapia with user assigned categories



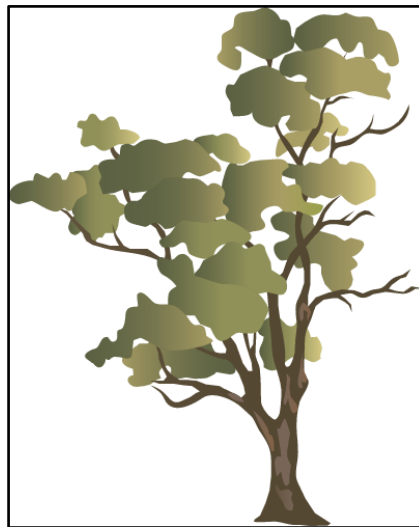
(Source: Wikimapia 2011)

Such a folksonomic approach can be viewed as a bottom-up and more ethical or democratic method of classifying information. In PAR 2 I had reviewed Wikimapia for its potential use within the SoOE. It originated in Russia and had unknown ownership and governance arrangements. The data for the Hobart area was of very low quality and contributions were mostly by people from distant locations. Such potential quality issues within folksonomies temper its democratic value compared to traditional classifications

that incorporate expert peer review. Classifications produced by experts through a top-down process can be relevant, credible, legitimate, well-intentioned and beneficial (Hayman & Lothian 2007). Due to the issues with Wikimapia it was only used to demonstrate GeoWeb 2.0 applications to participants. At the time, it was unknown if there were other FGW2S providing the ability to group layers with a folksonomic approach. Later ESRI (2014) demonstrated the incorporation of tagging within ArcGIS as a more user friendly way of adding metadata than traditional, formal metadata standards and formats.

Following from comments regarding the default icons provided in Google My Maps, I began to investigate how this could be improved. No off-the-shelf options were found. Louie had provided a reference to the online image and icon sharing web site called the Integration and Application Network (IAN 2011). I used an image for significant trees (Figure 5-2), and experimented with an application that made drawings out of photos.

Figure 5-2: *Eucalyptus camaldulensis* image from IAN used for icon in SoOE Map



(Source: IAN 2011, image created by Kim Kraeer and Lucy Van Essen-Fishman)

After many technological frustrations, new icons for significant trees were created and the process written about and attached to the SoOE Wiki.²⁴ In both cases the process was lengthy and the icons created were sub-optimal. This was another example of how it was not always easy to achieve my objectives, regardless of the availability of FGW2S and other resources. Later, developments in Google Maps Engine provided more options for

²⁴ <http://stateofourenvironment.wikispaces.com/Custon+icons+for+Google+My+Maps>

icons, but not in the free versions. It is not possible to know definitively if it has become easier to tailor icons in later software versions, or that these options existed at the time, but were not apparent, due to the time needed to search and discover resources.

5.1.2 Offline participation: creative commons and communicating

A significant contribution by email (Evan) was a reference to a presentation on the introduction of creative commons licensing into Australia (Fitzgerald & Hooper 2011). Exposure to creative commons broadened my understanding of the relevance of social arrangements as well as technology for GeoWeb 2.0. Creative commons provide the legal basis for the sharing and reuse of information and other intellectual property. The technical basis for the ability to reuse and combine different geospatial information is supported through the development of standards to support interoperability by organisations such as the Open Geospatial Consortium (De Longueville 2010; Haklay, Singleton & Parker 2008). This participant was also interested in how to use Google MyMaps for personal use and, like Anneka, had no technical GIS background.

During this cycle I presented an “interactive” poster entitled “Crowdsourcing Environmental Sustainability? Opportunities and Issues in Using the Interactive Internet for Environmental Management”, at the University of Tasmania Sharing Excellence in Research Postgraduate Conference on 1-2 September 2011 (Figure 5-3). This was an opportunity to test the research concept and its communication to a broad cross section of post-graduate students and faculty from across the University of Tasmania, and provided another perspective on understandings of the concept and preparedness to engage. As there is no real boundary between communicating and doing (my) research, during the process a record was kept of how people interacted with the poster. A report was written and posted on the SoOE Wiki²⁵ on 2 November 2011. A summary was also provided in SoOE update report four, with a link to the full report to communicate the research ideas to wider participants.

²⁵ <http://stateofourenvironment.wikispaces.com/file/detail/PGradConfPosterPresentWrapup.docx>

Figure 5-3: Last photo of complete poster at 12:36 on 2/9/2011



Participants were invited to complete the poster from disparate pieces of a map of Tasmania. Through this process the following observations were made. My relationship with participants was vital and many participants were those with whom I had a prior relationship. My role and who I am, are crucial to whether people participate and how. Most people I talked with understood the concept; one commented it should be developed as a commercial venture, with the main reservations about information reliability. About 15-20 people participated, out of approximately 150 attendees. A few participants did most of the work, with one participant completing nearly all the poster. These rates accord with observations reported in the literature of participation in other crowdsourcing projects. As far as I can determine, no-one participated without my presence or encouragement. The reasons why people participated the way they did were not always easily understood, sometimes even by the participants. For example, I queried why a participant did not move a wrongly placed map piece:

Me: “Why don’t you move Lake Gordon?”

Participant: “I don’t know where it should go”

Me: “But you just showed me where it goes”

Participant: “Mm”

Me: “So why don’t you move it”

Participant: “Not sure”.

This participant was a fellow student, well-educated and articulate but still could not describe the reason for their reluctance.

The position of the poster at the conference strongly influenced participation. I was placed separately from the other rows of posters and slightly elevated, advantageous in allowing additional viewing space. However, this position was not in the flow of those viewing the other conference posters and hence easily missed, which was a disadvantage. Receiving the people’s choice award but not one from the official judges indicates that what constitutes good research communication varies amongst audiences. There are multiple “qualities” relevant to different audiences.

The experience demonstrated that the idea interested people, they understood the concept and the interactive approach attracted and engaged people. Significantly, many of those who contributed to the map were not geography and environmental management students, but from other disciplines. This experience affirmed my perception that “position” and how I present myself will strongly influence the results. The journey of making and presenting the poster was as important as the outcome of communicating the research. Making the poster involved many of my colleagues in the spatial sciences school as I sourced pieces and designed the poster. Importantly, interactions throughout the process led to new participants in the research project, and insights being volunteered such as emerging geospatial platforms for environmental management.

5.1.3 Reflections: disciplines, certainty and communication

During this cycle, I reviewed the publication *The SAGE Handbook of GIS and Society* (Nyerges, McMaster & Couclelis 2011). I found this book after reading a paper on technological change (Osborn 2001), that I wrote about and attached to the SoOE wiki²⁶.

²⁶ <http://stateofourenvironment.wikispaces.com/Technology+change>

The book opened my eyes to research relevant to GeoWeb 2.0 from other perspectives such as studies of GIS and Society, and Critical GIS. Before this, my understanding of the implications of the technological changes underway came from my own observations and readings on the broader Web 2.0 phenomena. This was the time my research broadened beyond the focus of the University of Tasmania School of Geography and Environmental Studies discipline of Surveying and Spatial Sciences.

Studies of GIS and Society acknowledge and articulate how “social, political and economic power are negotiated in and through GIS and cartography” (Elwood 2011, p.381). Of particular interest is the statement that space can provide a means to bring together quantitative and qualitative information (Janelle & Goodchild 2011), a divide of considerable debate in the literature (Sui & DeLyser 2011). After writing about the book in the update report and including a link to further online information, Roland, a GIS professional, requested copies of some chapters. The PAR process can, then, directly inform developments outside the academy.

With the knowledge gained through this research the relevance of Qualitative GIS perspectives (Cope & Elwood 2009) to Web 2.0 and GeoWeb 2.0, is now clear and could also have better informed the research design from the outset. I make this clear to show how what we can know is influenced by the time and place of observation and lens, or perspective, through which we observe. My journal pages 118 to 122 recorded ongoing reflections on qualitative research methods, and how my ontology and epistemology might be affecting my position within the research, and how others positioned me. The introduction below, written in the original update report was trying to achieve a tone that was personal and not authoritative, following the recognition in PAR of how unequal power relationships affect research participation and collaboration:

Hi folks,

Oh my goodness it is November already, two and half months since my last report - where does the time go? Actually, this report has been niggling away at me for a few weeks. I have been trying to avoid it for fear of not having enough to report. But the show must go on ...

On reflection now, this tone can also be interpreted as tentative and lacking in confidence. Such were similar comments from my research supervisors regarding other examples of my writing. They wanted more objectivity, more definite statements, a reflection of a

prevailing culture that links validity and authority to confidence, definiteness and certainty. To be successful one must appear confident and certain; humility and uncertainty are interpreted as lacking in conviction and hence validity. In contrast, within Action Research the measure of quality as plurality of knowing requires that we “be humble in keeping with our ignorance of all that could be known and cultivate a rigour of uncertainty” (Bradbury & Reason 2001, p.451). This is an alternative worldview recognising the inevitability of uncertainty and a requirement for humility about what we know and can know, and how many current problems are linked to the desire for certainty and the hubris that attends those who claim it (Allenby & Sarewitz 2011; Harris 2007; Kahneman 2011).

On journal page 120, I reflected on the poster presentation described earlier and trying to describe my research to a very different group of researchers, such as in pharmacy and public housing. Such difficulties and questions about what I meant by “sustainability” and “management” prompted reflections that I should not try to define these terms too rigidly as multiple ontologies and epistemologies were relevant and needed to be included.

If you decide up front you limit part of the knowledge domain, you exclude (AC journal p. 122, 23/8/11, Figure 5-4).

Before reading GIS and Society, I was reflecting on the view that the role of context and position, including both physical and social dimensions could be in providing a method to align multiple interpretations, in effect grounding them in place. Hence, the aim should be to, as written in my journal:

Build a system that supports the expression of multiple ontologies and epistemologies, and (that supports) debates between those who maintain specific positions within (each of) these about which is most important (don’t intend to resolve this) (AC journal p. 122, 23/8/11, Figure 5-4).

Davis and Fonseca et al. (2011, p. 131) express this as one of the major challenges in using GIS for sustainability. I thought that place had the potential to assist by allowing people to:

Be able to transparently make the connection between the abstract, generalised, aggregated (information that represents reality), and the specific concrete realities they are meant to be constituted of and represent. There is often a disconnect between these two, and I think it is possible to connect them with geography, social position.

People's ability to change the physical realities of their lives is determined by their ability to see and trace the connections between these and the broader, macro, physical realities that constitute the overriding forces.

Part of my ontology is that the achievement of social change such as lasting sustainability requires the consent of the majority of people and their active willing participation to change. This cannot be mandated and enforced upon the population who will find ways to subvert, especially when the more empowered they become, and their subversion is potentially more dangerous due to the power individuals can wield and the interconnectedness of the world (social / human). Any action has potentially greater impacts given the greater interconnectedness of the world just by virtue of population alone (AC journal pp. 122-23, Figure 5-4).

There is the need for participation to be willing, otherwise the disengaged and disaffected are motivated to subversion and radicalisation. An increasing power to disrupt through the availability of off-the-shelf technologies (DSTO 2013) and the increasing interconnectedness of human society and fragility of the environment (Harris 2007) has the potential for such disaffection to have major consequences.

Organising my journal by indexing and coding my research notes commenced in this cycle. Certain codes were repeated and I resolved to look for these patterns in the literature and my observations. Some were higher level concepts (Cope 2010) and I explored options to represent this, comparing a network and hierarchical representation. The former clusters lower-level concepts around a higher-level concept, whereas in the latter, lower-level concepts are contained by the higher-level as in a parent-child relationship. The latter makes it difficult to represent the often multiple and overlapping relationships possible, modelling network relationships was more difficult. It was also two-dimensional, whereas in my mind many of the networks required three dimensions to represent the relationships (AC journal p. 180, Figure 5-5).

Figure 5-4: Research journal pages 122- 123, highlighted areas transcribed as quotations

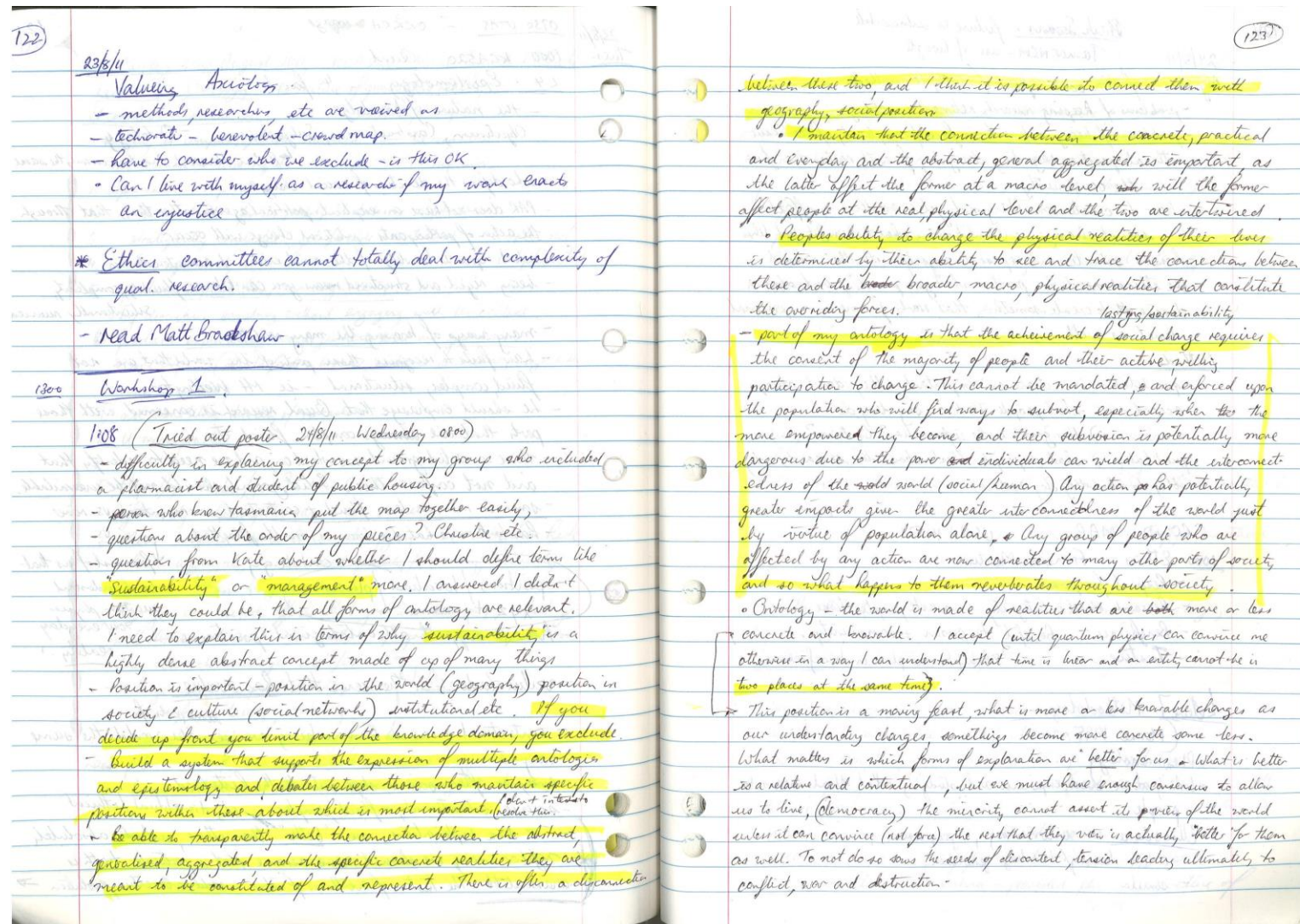
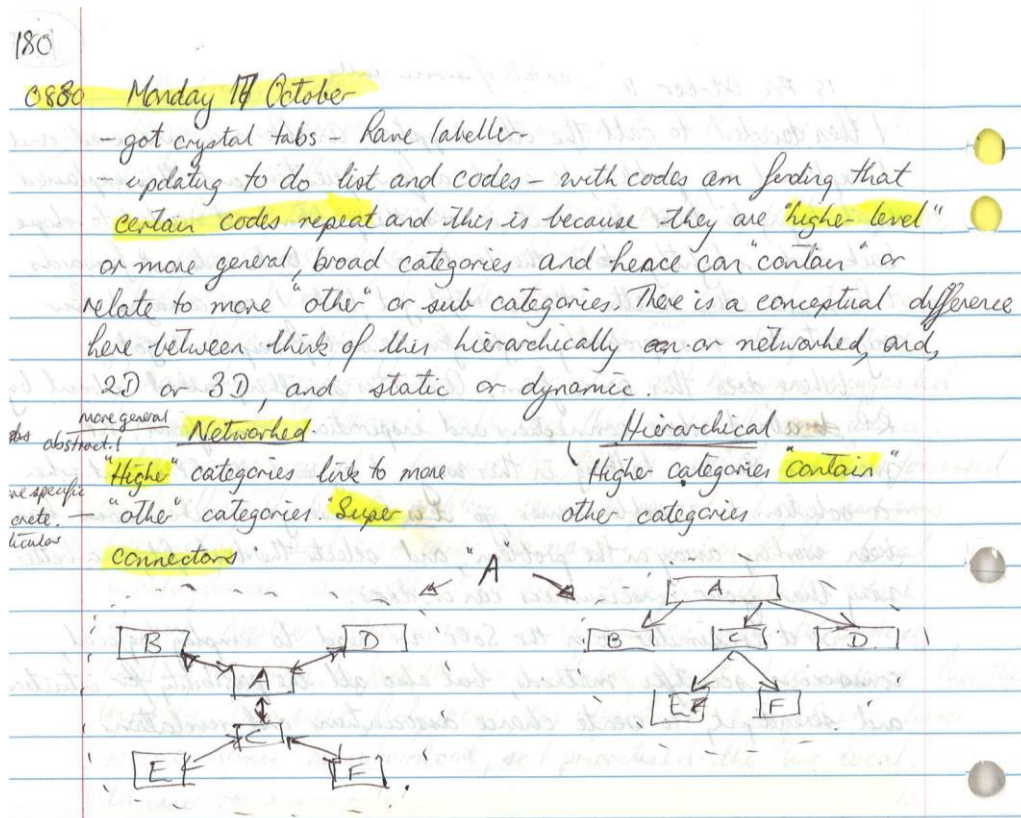


Figure 5-5: Journal page 180, 17 October 2011



The SoOE wiki also presented this problem, with the primary navigation pane representing a hierarchical organisation. These are interesting examples of how world views, ontology and epistemology, are embedded into technology and thereby constrain how the world can be modelled.

5.2 PAR 5: Emergent methods and perspectives

In PAR cycle 5, from 5 November 2011 to 27 March 2012, 108 journal pages were written. Four files were added to the SoOE wiki (Table A-7) and one site to the SoOE Map (Table A-8).

5.2.1 My online participation

The most significant part of my participation was the water leak detection that began midway through 2011 and culminated in an outcome early in 2012. I had used the SoOE Map to identify and describe a leak of potable water discharging into Lindisfarne Bay via a stormwater drain. The locations of relevant sites were placed on the SoOE Map. When communicated to the water authority this resulted in the leak being fixed. I wrote about the evolution of the issue on the SoOE Wiki²⁷ and I made it the focus of update report five. Its significance to environmental sustainability is highlighted by the following statement made in a report on the value of spatial information for Tasmania (ACIL Tasman 2011, p.viii):

Improvement in the efficiency of water management and natural resource management through better planning and management supported by spatial information could feasibly deliver value in the order of \$1 million per year from a 1 per cent improvement in the efficiency of water resources management. This is considered a possible outcome as a result of better use of spatial information in the water sector.

Water use efficiency and water conservation for environmental purposes are directly impacted by leaks in the supply infrastructure. The use of GeoWeb 2.0 platforms for this purpose illustrates their power in allowing broad-based community participation in environmental management by sharing information.

Such a use was different from reporting the same issue in person, by telephone or writing in email for several reasons. Firstly, the SoOE Map facilitated my understanding of the issue and helped to decide whether it was a pollution or water conservation issue, once off or chronic, its origins and at what times it was happening. This was a practical demonstration of how GeoWeb 2.0 provides tools and resources to support spatial reasoning for understanding processes and solving problems (Janelle & Goodchild 2011). Placing my observations on SoOE Map allowed me to communicate to the water authority very succinctly and efficiently this understanding with less uncertainty than the usual methods of communication. Finally, the issue was described transparently in a public space, was persistent and hence not easily ignored or

²⁷ <http://stateofourevironment.wikispaces.com/Water>

dismissed. The data are also thereby available for other stakeholders, such as competing water users or community environmental groups.

Similar use is possible for anyone with the literacy to use these platforms. They do not need a computer or internet access if these are made publicly available, such as in local libraries. If they use their own computer and internet access, they do not need to own the software or any data. They can locate issues with reference to supplied background imagery, so do not need any location recording devices such as a GPS receiver or smart phone. This represents the potential for a substantial shift in the way society can organise its operations through the power of a geospatial view of information (Janelle & Goodchild 2011) and the attending social potential (Warren 2011) of a spatially-enabled society (Williamson, Rajabifard & Holland 2010).

Awareness of the capability to involve citizens in civic action was apparent in initiatives such as Adopt-a-Hydrant (Code for America 2011) and the smart phone app Snap-Send-Solve (Outware Media 2011). Theoretically these developments might be better conceptualised as what Thatcher (2013) calls volunteered geographic services (VGS) rather than just VGI:

As a concept VGS ... entails any system where volunteered geographic information is coupled directly to an exchange of services, broadly defined (p.165).

The water leak example illustrates an important point about VGI and self-selection. The incident required considerable expertise to recognise the issue and to understand the significance of the location. This provides another perspective to concerns about VGI not being representative, that in fact it can over-represent certain interest groups (Brown & Kytä 2014). This is not necessarily a problem in circumstance such as the water leak, for having a representative selection of people submitting VGI would not necessarily provide better data. In such cases the motivation, expertise and attitude of the person volunteering information is more important.

5.2.2 Offline participation: concerns and interests

During this cycle, most of the concerns expressed by participants constituted barriers to online participation. For some, there were problems using the interfaces or adjusting to changes in the technology. Nichole said this was particularly so for the older people they knew, with many of

them just using email and no other internet resources. Kris countered this by saying older people had more time available and hence ability to adapt. The way retired travellers, often referred to as Grey Nomads, use Web 2.0 platforms such as “The Grey Nomads” (Giant Media 2005) to share travel related information confirms this for some older people.

For Connor a major concern was how participating online might affect their privacy and security when sharing information. This was particularly due to the need to register on platforms, with their concern centring on how this could be used to capture personal information that might compromise their future security, work prospects or friends and family. Connor was a participant I classed as an expert in GIS and GeoWeb technology. Also important for him was a reluctance to give away intellectual property rights where substantial input is involved. The issue of potential loss of intellectual property was expressed by two others, Pierre and Sam, both experts in the use of GIS. For other environmental professionals (Trevor and colleagues), concerns arose about how the community sharing of information might compete with their professional roles and hence undermine future working life and opportunities. Their jobs and livelihoods might be threatened if what they did could be done by community volunteers. These are understandable reasons not to participate and can only be made by the individuals concerned.

Otherwise, participants were interested in easy ways to collect and distribute information, mentioning the photo sharing applications of Flickr and Instagram. Participants communicated an interest in the use of the GeoWeb 2.0 for purposes such as emergency management (Roland), managing feral animals (Barry), education, community land/coast care, environmental impact assessment (Daphne) and noise monitoring (Trevor). These responses show an interest in the developing technology for a broad variety of purposes. An invitation to present to a walking group suggests that some require ongoing support to translate this interest into action. Later, others did so of their own accord. In Stage 2 I identify options such as the Social Media and Landcare workshops that provide pathways for uptake. Participants feedback also revealed the components of GeoWeb 2.0 that were most visible, such as GeoWeb 2.0 platforms and smart phone applications, with most examples being institutional platforms. Interestingly, in comparison amongst the University of Tasmania students in the classes to whom I delivered lectures, there was a lack of awareness of even these.

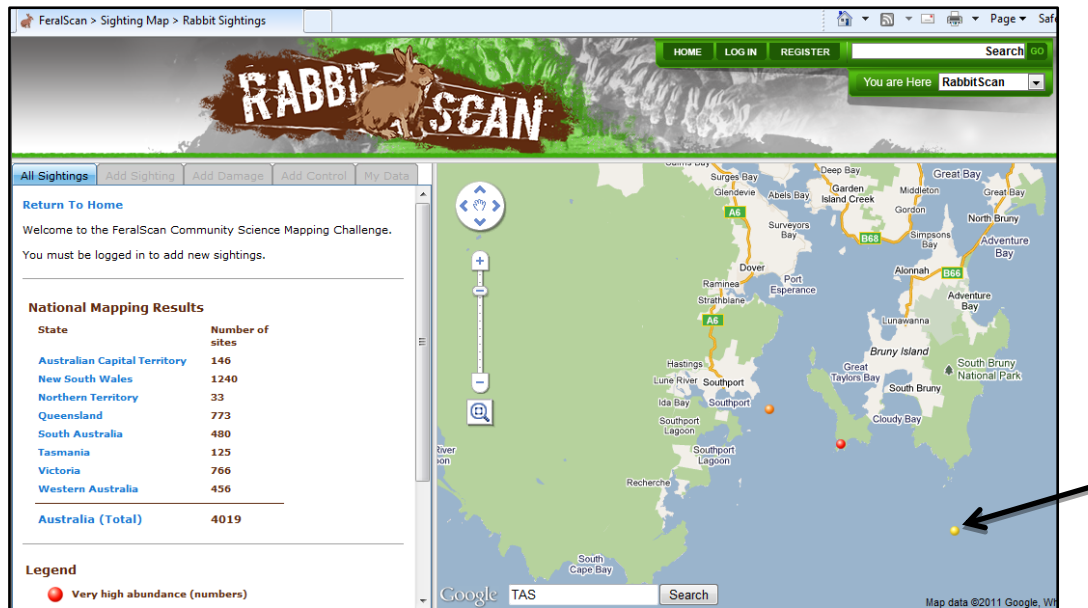
Concerns were also expressed about the quality of community generated information by Alan and Warren, such as inaccurate bird sightings volunteered to Birddata (BirdLife Australia 2014),

then transferred to ALA and used by government for conservation policy. The inaccurate contributions were often from interstate visitors, confirming other research (Coleman, Georgiadou & Labonte 2009; Flanagan & Metzger 2008) suggesting proximity of the volunteer to the phenomenon as a useful indicator of credibility. FeralScan (IACRC 2011a) also exhibited quality issues with volunteered rabbit sightings occurring in the ocean off Tasmania's east coast (Figure 5-6). The example shows how placing the information within its spatial context can make quality issues more transparent. Whether uncertainty is "obvious" depends on the expertise of the viewer, and the uncertainty in the example of volunteered bird sightings, also PAR 5, may only be apparent to those who understand the range and habitat of the species. The response within the Web 2.0 literature was that exposing such data to many eyes via the web and allowing others to identify and perhaps correct such errors would lead to improvements in quality over time (Shirky 2008, 2010; Tapscott & Williams 2008).

Haklay (2010) analysed the quality of VGI in OSM and found it comparable to the Ordnance survey, but while quality varied randomly in the latter, it was more closely related to particular contributors in OSM. Haklay also highlighted the need to analyse how different aspects of quality, such as positional accuracy and completeness, varied in VGI datasets compared to authoritative data sets, noting the paucity of data in OSM describing poorer localities. In a later case study of OSM for the Denver area, Mullen et al. (2015) found no relationship between demographics and the positional accuracy and completeness of data describing schools. These differences highlight the heterogeneity not only of VGI but also factors affecting contributions of VGI, and hence of generalising beyond contexts.

Nichole also expressed concerns about the reliability of Web 2.0 platforms in terms of their long-term continuity, a concern that Haklay (2010) also raised regarding the continued engagement of volunteers in VGI platforms. For Harry, the emergence of big data raised issues of information overload, difficulties of discovery and synthesis. They thought that in the early days of the internet it was possible to trust more the reliability of information, as the early net inhabitants were homogenously idealists, and now the echo chamber and filter bubble effects (Pariser 2011) could skew and bias what was found.

Figure 5-6: FeralScan data quality issues with rabbit occurrences off Tasmania's coast



Source: (IACRC 2011b), accessed 24 May 2011

Of influence on my thoughts and direction was feedback on my review of the environmental GeoWeb 2.0 portal, RedMap, from a member of the RedMap team, who was concerned that I had said it was not very open. The review I wrote was an attempt to identify the extent to which the Web 2.0 paradigm of openness had been incorporated. I was referring to the capability to add only a limited set of information to the online site, whereas they pointed out the RedMap team were open to email and telephone contact. I offered to add the respondent's comments to the wiki but did not receive a reply. The effect on my direction was to cause me to examine more closely what was meant by the idea in Web 2.0 of 'open' and openness, eventuating in my paper (Clark 2014) incorporated in Chapters 2 and 9.

5.2.3 Reflections: Methods and describing GeoWeb 2.0

The tensions arising from my attempts to create order and write a traditional PhD led me to seek guidance on the process of using a PAR methodology. Herr and Anderson (2005) is an excellent resource, describing many of the issues I faced with examples from other Action Research students' work and experience, as well strategies for addressing them. In the chapter "Designing the plane while flying it", Delong's (Herr & Anderson 2005, p.81) comment to

“just trust the process”, was timely and I began to do this. Through this I also began to understand PAR as part of the wider tradition of Action Research. As my position and role within the research had changed, my practice was closer to several varieties of Action Research, than PAR, depending on the insider – outsider status of relationships with other participants. My own participation as an insider studying their own practice was an auto-ethnographic approach.

Each update report became harder to write as I struggled to convey succinctly all that occurred and my unfolding understanding of the emerging GeoWeb 2.0. At this stage I realised how, at the beginning, I assumed a great deal about the visibility of GeoWeb 2.0. It was now apparent that the developments of Web 2.0 had been incorporated with GeoWeb far more than was previously understood, but a comprehensive understanding of GeoWeb 2.0 was largely unavailable to most Australians. Therefore, in the report I articulated more on how my understanding had changed over the last 4-6 months and why. To do so comprehensibly to a broad audience I used a natural metaphor, likening GeoWeb 2.0 to waves of change originating from “seismic socio-technological events” centred on North America and Europe, that interact with the local landscape and each other in amplifications, reflections and diffraction patterns. Australia and Tasmania were not at the centre of evolution, and how change emerged at the centre was not how it may manifest here, as local conditions and interactions created unique local effects. Within all the complexity the metaphor implied, the fixing of the potable water leak crystallised the implications of the change afforded by GeoWeb 2.0 for myself and perhaps many of us, in terms of our ability to be individual actors in sustainability.

Leszczynski (2011) seeks to situate the origins of GeoWeb 2.0 in the expansion of neoliberal capitalist economy where a roll back of the state production and control of geo-information has corresponded with a roll out of market-based production and control. Any democratising potential of GeoWeb 2.0, must be interpreted in light of the commercial focus of many of the major platform providers and the resources they command (Haklay, Singleton & Parker 2008; Leszczynski 2011). The commercial drivers for Web 2.0 consist of engaging consumers to help build better applications and rich information sources (databases), that then attract more consumers, but are also valuable in their own right as potentially saleable products (O’Reilly 2007). For GeoWeb 2.0 it is the ability to create the pre-eminent physical and social model of the human world or universe that becomes the dominant internet platform (Austen 2013; Stefanidis, Crooks & Croitoru 2015).

The resources and hence power available to large commercial ICT companies are substantial: in 2011 Google had a revenue of US\$37,905 million (Google 2012b), approximately 25% of Australia's GDP (official exchange rate) of \$150,700 million for that year (CIA 2012). Substantial financial resources had been required to develop GeoWeb 2.0 with many hundreds of millions of dollars invested in Google Earth (The Economist 2007). A commercial only focus of private sector initiatives is, however, complicated by their community development initiatives, such as Google's outreach program (Google 2012a), IBM's corporate responsibility program (IBM 2012), and Microsoft's support of OpenStreetMap (Microsoft 2010).

Tax revenue for public sector initiatives may provide a more constant funding base, but the bounds of that funding base appear more limited and under stress (Leszczynski 2011; McDougall 2010). Public sector initiatives are driven by the political concerns of their constituents and hence can be viewed as having "public good" interests as primary motivations. Government also has, however, a role in ensuring economic viability and is motivated by the role of the spatial industry in underpinning economic activity (ACIL Tasman 2008, 2011). For both the public and private sector, resourcing is a major issue for technologies that require substantial hardware, software and human capabilities to develop and maintain. This resourcing is perhaps then also a major factor motivating many public-private sector alliances in large-scale projects.

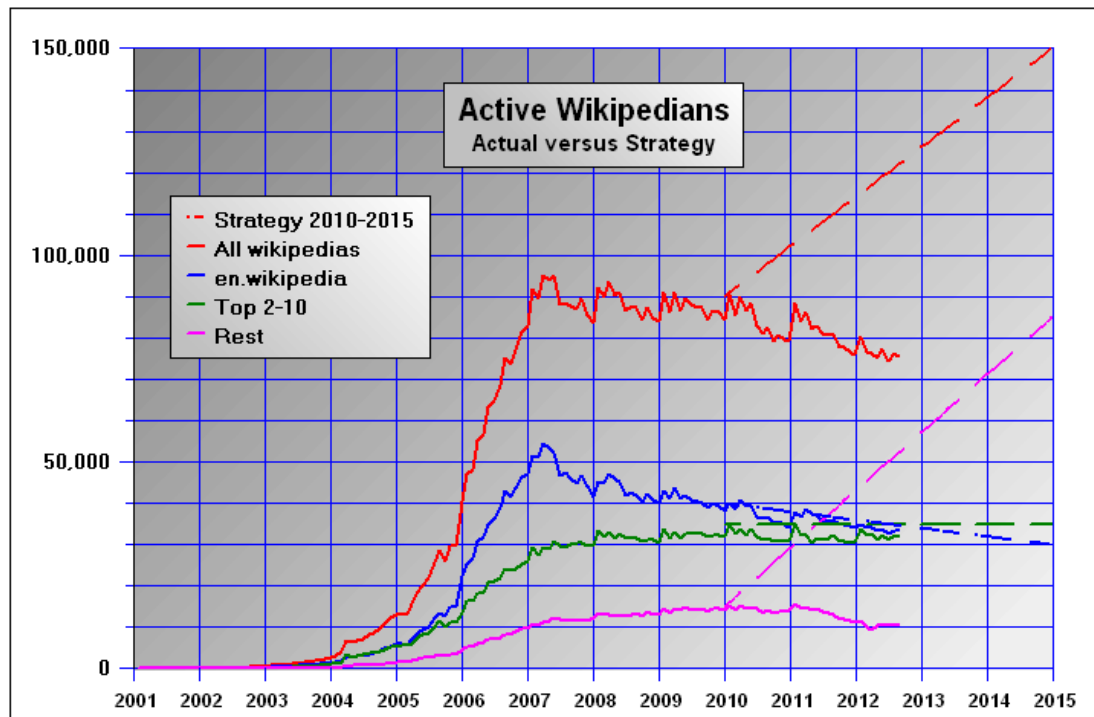
The third sector and open source movements are providing alternatives, with initiatives such as OpenStreetMap and Wikipedia gaining sufficient size and spread to become definitive sources. Wikipedia's sporadic request for donations is a different, direct public funding model, neither as commercially or political focussed as private and public sector actors. The small amount of time (50 days) a recent request (The Economist 2011) was on the Wikipedia site indicated funding this way was effective, but Figure 5-7 depicts active Wikipedians peaking in 2007, and suggests maintaining growth in active participation is a challenge.

There are, however, few clear-cut boundaries between the private, public and private sectors with examples of collaborations between variations of all three. For example, at a global level the European Commission's Eye on the Earth initiative (European Commission 2011) incorporated both ESRI's ArcGIS and Microsoft's geospatial capabilities²⁸ while more locally two other public access environmental geoportals, Connecting Country Community Web

²⁸ The eye on the earth website no longer exists, with features being continued by contributing agencies

Mapping portal (Spatial Vision 2012) and Placestories' Digital Landcare (Feral Arts 2008), are both collaborative initiatives between community, government and private enterprise.

Figure 5-7: Active Wikipedians, number of volunteers, 2001-2015, depicting plateauing of growth in participation



Source: (HenkvD 2015)

The factors influencing the manifestation of GeoWeb2.0 at a macro scale are a complex mix of economic and social drivers emanating from the private, public and third sectors, including both competition and co-operation between these agents. Collaboration was identified as a hallmark of the Web 2.0 phenomena (Tapscott & Williams 2008), as well as other complex adaptive systems (Harris 2007), while competition is also a well described driver identified in evolutionary and organisational theory (Flannery 2011). This suggests that different socio-political contexts will influence how GeoWeb 2.0 manifests with a major difference between North America and Australia. The former is the origin of the largest commercial ICT organisations that are creating the dominant GeoWeb 2.0 platforms. While these platforms are also available in Australia via the internet, there are no equivalent Australian commercial organisations or platforms. Australian GeoWeb 2.0 platforms mostly emanate from government and other non-commercial organisations such as research institutions.

Understanding this is partly the role of research institutions and normally communicated through the academic literature. By 2011 the literature from North America and Europe is well developed (Batty et al. 2010; Budhathoki 2010; Budhathoki, Bruce & Nedovic-Budic 2008; Coleman, Georgiadou & Labonte 2009; Crampton 2008; Elwood 2008a; Elwood & Leszczynski 2011; Goodchild 2007a, 2007b, 2009; Goodchild & Glennon 2010; Haklay, Singleton & Parker 2008; Leszczynski 2011; Sharl & Tochtermann 2007; Warf & Sui 2010) but the different socio-political contexts suggest its applicability to Australia requires analysis. The Australian academic commentary on GeoWeb 2.0 appeared sparse, while the surveying, spatial science and industry journal *Position* ran articles on GIS for Gov 2.0 (Bundock 2010) and Emergency 2.0 (van der Vlugt & Hornery 2010), crowdsourcing (Hicks 2012; Young 2011) and smart phone apps (Chester 2011). Literature from public institutions was difficult to locate or not widely available for public consumption and I became interested in exploring this further.

5.3 PAR 6: Beyond the SoOE

In PAR cycle 6, from 28 March to 1 August 2012, I wrote 80 journal pages and distributed update report six, the last. This report was sent by email to more participants (65) with whom I had interacted and to whom it might be of use and interest, beyond those registered on the SoOE (18). It was made clear that if anyone did not wish to receive such emails they could indicate this by a quick return email or anyone who wanted to become a collaborator on any of the SoOE platforms could request to do so. No-one did this.

5.3.1 Diversity of GeoWeb 2.0

My work with the SoOE Map languished during this cycle for several reasons. As well as the emerging technical limitations expressed earlier in Chapter 4, an increasing awareness of emerging platforms and applications consumed my attention. These raised questions regarding to what extent another separate SoOE type platform should be created with these existing and well supported alternatives. Also, inhibiting action were increasing concerns regarding the ethical issues of encouraging online participation, such as personal security, privacy and loss of intellectual property, as described in Chapter 4.

An unexpected and unsought collaboration came when a colleague drew my attention to three other free cloud-based GIS platforms: Crowdfmap (Ushahidi inc. 2012), Geocommons (ESRI 2012) and Umapper (CrabDish 2012). I had tried to register on Crowdfmap in 2011 but there were problems with the server at that time. This time I could register on all three, but could still not work out how to use Crowdfmap. Another collaborator, a GIS expert (Connor) reported the same. This was strange given the platform's creators reported widespread use. It was Geocommons that appeared the easiest to start with, mainly because of its up-front option to upload KML files, those used by the SoOE Map. This use of interoperable data formats was essential to enable sharing and reuse of information between the separate platforms. With a few simple steps, I could download all the information from the SoOE Map and display it in a Geocommons version.²⁹ Most of the points, text and hyperlinks and embedded photos appeared to upload correctly. Different layers could be displayed, but to do so each layer had to be in a separate file before uploading. This was slow and cumbersome, but worthwhile pursuing as an exploration of potential alternatives.

²⁹ <http://geocommons.com/maps/186296>. When I tried to log in 2015 it was no longer working

During 2012 three new interactive mapping portals of particular interest for environmental management were developed in Australia. These were Local Harvest (Ethical Consumer Group 2012), about local food and food sustainability; Coal Seam Gas Map (Getup! 2012), publishing people's concerns about coal seam gas mining; and the Connecting Country Community Web Mapping Portal (Spatial Vision 2012), landscape scale mapping of community conservation efforts. Notably all three are community based, or collaborative initiatives between community, private and government organisations. This appeared to signal a spreading awareness of GeoWeb 2.0 throughout the Australian community, and possibly a maturation of the technology in lowering barriers for its use.

The emergence of such platforms offered choices for community participation, but the diversity of options created the issues of deciding which platforms to use, the time required to learn how to use them, and then, if multiple platforms are used, the fragmentation of personal information. Regardless of ease of use, time is always required to learn how to use each platform, and I found a marked difference in the usability of FGW2S. Any such time investment carries a risk of being misplaced if the platform chosen is discontinued or otherwise fails. With a multitude of different FGW2S and platforms available, being able to assess the advantages and disadvantages of each helps inform decision making. The FGW2S Wikimatrix (CosmoCode 2011) provides a comparison of the features of wikis. To create such applications, however, requires a well-reasoned set of criteria that are resistant to change. Identifying such criteria for GeoWeb 2.0 more broadly is complicated by its nebulous and fast changing nature.

Further, I found that no one platform offered functionality for all my interest areas. The alternative was then to use multiple platforms and FGW2S. However, the more I used different FGW2S, the more fragmented my personal information became. Interoperability between platforms is then essential to move information between the separate FGW2S; such as if one becomes inoperable or alternatively adds functionality. Interoperability also provides the possibility for the aggregation and synthesis of information in a mashup (Batty et al. 2010). Use of these FGW2S and platforms often requires registration with a username and password and a need to keep up to date with each. Ostensibly this is helped through services such as email updates and newsletters. These, however, also constitute an additional administration burden and potential overload of information.

The multiplicity of FGW2S provides openness to different epistemologies and ontologies with potential to challenge the power relations underlying who can create and distribute information.

Finding which to use becomes an issue and the many options available may be paralysing. Schwartz (2009) describes this as the paradox of choice, where more choice is less satisfactory, providing another perspective on the positive view of the endless choice in “The Long Tail” (Anderson 2006) enabled by Web 2.0. The diversity of FGW2S can lead to emergent problems of information overload and fragmentation, new barriers to participation that feedback onto the power relations underlying the democratisation of information.

5.3.2 Quality and context

Assessing the quality of VGI enabled by GeoWeb 2.0 is not a trivial problem and is becoming the focus of much research, with the journal *Transactions in GIS* producing a special edition on volunteers in GIS (Jones, Mount & Weber 2012). Elwood et al. (2011, p.99) observed that “most discussions of VGI frame (these) differences in the information contributed as problems of accuracy and reliability”. Alternatively, “a critical GIS-informed reading ... suggests that these contradictions in volunteered information may well be indications of social and political difference” (p.99). Hence, while the bird observations submitted to Birdata may be of the wrong species, they do accurately convey the volunteer’s interest in participating in sharing bird data. A connection has been created through which a dialogue can be opened and the fitness of the information exchanged can be improved for all parties concerned.

Gruen (2012) described how the complexity of modern life makes it impossible for people to personally conduct due diligence assessments before every decision. An alternative to information users conducting their own due diligence, is for people to rely on the advice of trusted others (Bishr & Kuhn 2007). Social connections are crucial to this as they allow people to find those with relevant expertise and reputations upon whom they can rely. Bishr and Kuhn (2007) also hypothesised that spatio-temporal factors can be used in assessing trusted data, for example who was closest in space and time. FGW2S that support these functions, social networking services and Social media, become important tools.

Goodchild and Li (2012) discussed the problems of quality assurance and proposed three methods: crowdsourcing or exposing the data to many eyes, social relations whereby contributors develop reputations and hence trust, and geographic context, where geographic laws and relations are used. They did not discuss the “social” usefulness of the sorts of quality assurance methods and tools deployed on sites such as eBay (eBay Inc. 2012) and TripAdvisor (2012), with users contributing ratings and reviews on products and services. Such capabilities

can support social accounting (Cameron, Gardner & Veenhuyzen 2010) and socially-distributed curation (Liu 2010; Liu & Palen 2010), relevant to broad-based community participation in sharing environmental information and its products.

Flanagin and Metzger (Flanagin & Metzger 2008) situated concerns about the quality, reliability and value of VGI as issues regarding the credibility of the information source. Coleman and colleagues (Coleman 2010; Coleman, Georgiadou & Labonte 2009) identified how the credibility of information providers, and hence whose information is trusted, can differ amongst consumers and the type of information volunteered. Platforms such as TripAdvisor illustrate how quality can be crowdsourced post-publishing. TripAdvisor (2012) incorporates GeoWeb 2.0 capabilities, and both the use of social connections and the concept that quality is relative to the context, long discussed in the literature and enshrined in the concept of “fitness-for-purpose” (Agumya & Hunter 1997; De Bruin 2001; Devillers & Jeansoulin 2006a). Hotel visitors can rate, review and share information such as photographs about their experiences (Figure 5-8).

Figure 5-8: TripAdvisor overall reviews by visitors to a hotel, showing ability to segregate by broad types of Families, Couples, Solo or Business travellers

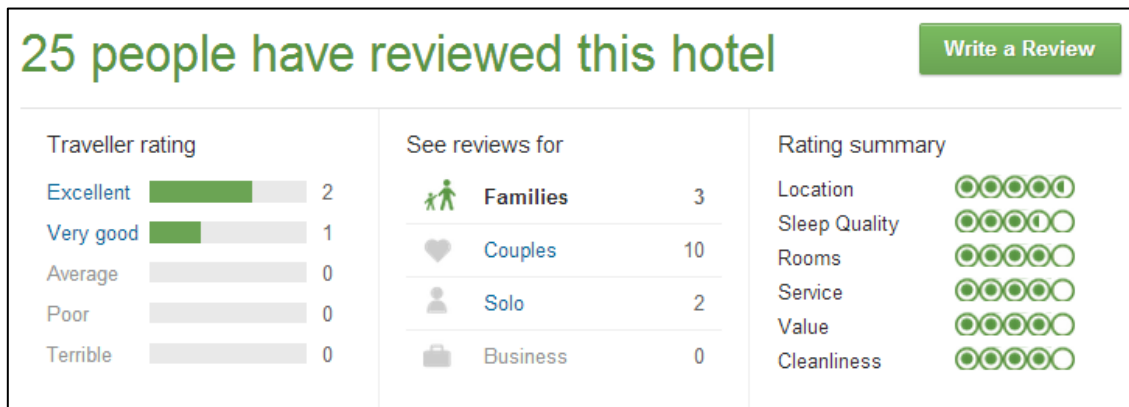


(Source: TripAdvisor 2012)

Importantly, TripAdvisor segregates the ratings of reviewers by their social category (Figure 5-18). They do not try to remove bias; they show the nature of the bias so that consumers can align themselves with groups with a similar bias. The reliability of reviews is partly assured by only allowing those who have booked and stayed to submit them. The right of reply is extended to the hotel owners, creating peer to peer connections and conversations about quality

experiences and expectations. The reviewers themselves can also be rated for quality aspects such as reliability, and hence build reputations that extend to the information they provided.

Figure 5-9: As above showing ratings for Families



(Source: TripAdvisor 2012)

Tsiotsou and Sigala (2010) examined the role of a “geo-collaborative portal” similar to TripAdvisor in supporting peoples travel decisions, finding a need to support multi-dimensional values. Mechanisms such as tagging, rating, reviewing and commenting extend participation to include the organisation and quality assessment of shared information by third parties. Fitness for purpose can then be ascertained relative to different users and contexts.

5.3.3 Australian context

The Australian Government policy and program environment consisted a multitude of diverse stakeholders and program developments relevant to GeoWeb 2.0, including geo-information, geoscience and GIS, ICT and the internet, and open information. Various agencies were attempting to coordinate this through development of a “Whole of Government Location Information Principles and Governance Framework”. A lead agency, the Office of Spatial Policy was also formed in late 2011, first located in the Department of Resources, Energy and Tourism and then moved in 2014 to the Department of Communications. There was considerable variation across the regions and tiers of government in the development of their initiatives. Western Australia and the Victorian governments were well developed, similar to the USA, UK and Canada. Queensland was publishing all its data under Creative commons license CC-YC, as was the Australian Capital Territory’s emergency services.

The first Australian Information Policy Conference (OIAC 2011) occurred in late 2011, organised by the newly formed Office of the Australian Information Commissioner (OAIC). These developments were part of the burgeoning open information agenda in Australia following from the declaration of open government (Tanner 2010) and are relevant to the proliferation of UGC and VGI. Presentations by Alan Noble (2011), Tom Burton (2011) and Richard Denniss (2011) highlighted the tension between openness and good governance. Burton, at that time Executive Manager for Gov 2.0 within the Australian Communications and Media Authority and a Web 2.0 proponent, maintained that engaging the community required “delighting” them. Denniss, however, cautioned that this could not be at the expense of accuracy and good governance.

Making sure information is appropriately open requires good governance, a part of which is information curation (Sui 2011). Resources and time are required for the information curation process and consideration of ethical issues, which stymies publication and the timeliness of information provision. Clear guidance is needed for when this is appropriate and relate to the type of information but also the context. Changing situations change the relative risk of being open or not, with emergencies an excellent example. Noble (2011), at the time Engineering Director for Google Australia, highlighted how in emergencies there is not the time to always ensure proper curation of information, as its value to the situation rests on its availability. The risk of keeping information closed can become greater than the risk of opening it up. Miller (2006) described how in the hurricane Katrina emergency, slow official responses were bypassed in favour of an unofficial and simple map mashup.

The complexity of the Australian government context is unlikely to produce timely results. Yet before this time a series of broadcasts on Radio National’s Future Tense program about emerging spatial technologies (Funnell 2010a, 2010b) conveyed a well-developed awareness and usage of the emerging GeoWeb 2.0 in the wider community. Spatial platforms such as Gowalla and Foursquare were being used to create and share VGI (Funnell 2010a). These were international and non-government platforms operating in a policy vacuum. Darren Mottolini, from Western Australia’s Landgate program, however, was enthusiastic about the positive benefits of incorporating VGI (Funnell 2010b). I began to wonder about the basis for such views, searching the literature specifically for Australian research, the results of which are summarised in Chapter 9.

The issues involved in using the diverse information made available by openness were conveyed by the Australian Bureau of Meteorology's (BOM) experience in developing a national water information facility (BOM 2011). Originating from a variety of regional water authorities, the data were extremely heterogeneous and required semantic mediation, a difficult and costly task. BOM had been subsequently tasked with incorporating all environmental information (Australia 2010).

5.3.4 Reflections

This reflection is necessarily short, as PAR 6 was the last cycle of Stage 1 and the next chapter is a meta-reflection for the whole stage. PAR 6 was a time of crossover with Stage 2, as I began exploring and implementing engagements with other initiatives. In the last update report I communicated that I would move away from the SoOE, only keeping it for my own practice but still open to anyone else.

Importantly, experiences in PAR 6 provided the catalyst for activities in Stage 2. At the BOM Water information briefing (BOM 2011), BOM personnel talked about how, during the recent (2011) Queensland floods, there were no rainfall recording sites at the centre of the high intensity cell responsible for most of the flooding, and hence it was not noticed early. It was thought that this type of situation was ideal for human sensors. This provided the catalyst for the interaction with BOM described in Chapter 8. My own position was crucial in these initiatives, as at the time I was employed within the public service and hence could attend briefings and workshops not open to the public. As an insider, for example through a Geoscience workshop, I could access government reports that were otherwise difficult to discover. Such views would not be available to a wider community. The tensions between open information, delighting and good governance expressed in the Open Information conference, mirrored my own difficulties with positioning within this research and to what degree I should lead and "delight". In Stage 2 my position was to change and I found myself increasingly an outsider.

5.4 Summary

The potential of GeoWeb 2.0 for sharing environmental information was illustrated by the water leak outcome and highlighted factors supporting individual action: making context explicit, supporting spatial reasoning and communication, publicly in an online context that

cannot be mediated and is persistent. I have worked in organisations where the public's phone calls are ignored and where information on an intranet has been removed. GeoWeb 2.0 has significant potential to support individuals as independent actors for environmental sustainability. However, the examples of folksonomy and taxonomy, and hierarchical and networked structures, demonstrated how different architectures of participation can be constructed that enable different worldviews to be represented. Each has advantages and disadvantages, the relative merits of which are context dependant.

Interpreting SoOE monitoring data as implicit feedback on viewer's interests could provide a means for co-direction in PAR. Being able to identify and understand audiences contributes to understanding who considers what information relevant to environmental sustainability. Specialist technical expertise is, however, required for reliable and in-depth analysis, thus limiting the democratising potential. Continued information publishing and linking to other popular platforms was identified as an important method for increasing attention. This can, however, contribute to the echo chamber effect where the relevance of information as measured by popularity is influenced more by publishing techniques, than by the salience of the information.

Cross checking communication of the research concept through a poster presentation provided additional data on the role of relationships and position in influencing participation. In other offline contexts, participants revealed barriers to online participation, perceptions of GeoWeb 2.0 and aspects of interest. Barriers to participation included ability to use the technology; concerns about loss of intellectual property; potential threats to privacy, security and existing roles; the long-term stability of platforms; and the quality of VGI and in heterogeneous big data. The increasing number and diversity of GeoWeb 2.0 platforms create issues of assessing their relative merits, information fragmentation, and the time and resources required to use and keep up-to-date. Heterogeneous big data are being created and new methods and tools are being developed and evolving to address the multiple qualities of information.

While cautious about online participation, interest was nonetheless expressed in aspects of GeoWeb 2.0 for a variety of environmental applications. I interpret this as participants balancing the benefits of participation against the cost from potential risks. Challenges to my own concept of openness, a developing understanding and participant's different awareness and understanding of GeoWeb 2.0, provoked questions regarding how different socio-political contexts influenced manifestations and perceptions of GeoWeb 2.0.

Within the Australian context a multitude of government agencies have interest in aspects related to the emerging GeoWeb 2.0, openness is being debated and across the tiers of government there are different stages of implementation of GeoWeb 2.0 and open information. Outside of government, Australians are using GeoWeb 2.0 applications from international providers to share information. Creative commons was identified as an enabling social arrangement significant for GeoWeb 2.0, reinforcing the importance of intertwined technological and social arrangements. Different political and demographic contexts, aspects of time and place, including structural differences, influence how GeoWeb 2.0 is, and will continue, to manifest in Australia. Exposure to literature from the perspectives of GIS and Society, and Critical GIS broadened my own understanding on how GeoWeb 2.0 could be perceived and analysed, relevant to evaluating the contribution of GeoWeb 2.0 use for sustainability.

In the next chapter I will review Stage 1, setting the scene for Stage 2.

Chapter 6 Review, reflection, methodology 2 (2011/12)

This chapter reviews and reflects on Stage 1, the original research aims and objectives, and methodology. It is a meta-reflection and synthesis that contributes to the research subjects and methodology. Each objective is addressed under Sections 6.1 to 6.3. Section 6.4 reflects upon how the experiences and wider readings of Stage 1 influenced my own worldview and the research methodology. The chapter ends with how Stage 1 informed the directions taken and methodology used in Stage 2.

6.1 GeoWeb 2.0 potential for sharing information

Through online writing about my research and use of examples to demonstrate the concepts, I confirmed that FGW2S have low barriers to access, and so allow individuals to publish environmental information to a broad audience. Much of what was published was done so easily and quickly without payment for software, data usage or storage. The resources required were my time, internet access, a computer and smart phone, hence such practice was not totally free. The online GIS, Google MyMaps, provided easy, flexible ways to attribute information to sites (locations) by linking to information stored in other FGW2S, in diverse formats such as text, photographs, reports, videos, presentations and other web sites. Although the FGW2S used have changed during the research, there was no corruption of the data as it was migrated through versions, and no corruption from other sources such as vandalism or virus attack.

The limitations of FGW2S were, however, quickly reached. Many technical problems were encountered as the SoOE developed that could not be resolved without lengthy investigations, learning or programming. Thus, it is mainly simple data and information that can be shared easily. Being able to construct more complex knowledge requires greater effort and expertise. For individuals, this means a greater personal investment they may not be easily met through the course of other life demands, reducing their ability to do more than share relatively simple data and information. Where power and influence arise from the ability to construct and publish more complex information and knowledge this will then accrue to those with greater resources.

I demonstrated, however, that the sharing of simple representations could still effect environmental change and contribute to sustainability. Through the information created and shared I could influence others to address a leak in municipal potable water supplies, thus

contributing to water conservation. Representing the information spatially in the SoOE Map assisted my spatial reasoning and understanding of the issue, and communicating this to key stakeholders. Exposing this information online made the issue publicly transparent in a way not open to mediation by partisan interests and available to other stakeholders.

The FGW2S used also provided easy-to-use capabilities to invite other interested persons to register on these platforms and collaborate in the research. Other registered collaborators could add their own content and post messages. This demonstrates the potential of FGW2S to support informal group formation, collaboration and co-operation without requiring substantial resources. Such capabilities raise the potential for informal groups to form, share information and collaborate outside of traditional institutional contexts. While only very limited information was shared, there were no substantial quality issues with this. The phenomenon were correctly described and located, despite those volunteering being a neophyte and interested amateur, as classified by Coleman et al. (2009).

These peer-to-peer connections are not as open to the influence or mediation of other interests. Regardless of the platforms being open to change by the other registered participants, no adverse changes were made such as the unwanted deletion of data, or posting of inappropriate content. This is in contrast to experiences in other Social media where the posting of malicious content, trolling and cyber bullying occurs (Anderson et al. 2014). I attribute this to the small, homogenous group of registered participants and low profile of the SoOE, as was identified for Wikipedia in its early days (Bishr & Kuhn 2007). This suggests that similar such initiatives will also avoid these problems. Importantly, the attempt for online collaboration stimulated offline collaboration, discussed in Section 6.2.

Capabilities within the FGW2S that “observe” online behaviour, such as the SoOE Wiki statistics, have potential to provide data that can aid in understanding participants and their behaviour. Knowing who participants are and their origins, when they participate and what they do when they participate could contribute to understanding the audiences to whom published information is being communicated and which aspects are of interest. The interest of participants can be interpreted as implicit indications of what they deem important and used within PAR as a means of co-direction. There are however many caveats on relying solely on this information, such as the reliability of the recording instruments, what component is actual human interest not automated, and to what extent simple quantitative observations can be

interpreted. Other sources of data must be used to cross-check such data and it is suggested here that this must include offline data.

Throughout Stage 1 many web applications utilising GeoWeb 2.0 capabilities to share information for environmental sustainability were discovered. These platforms, portals, apps, and web sites provide information and services, and describe programs and ideas covering a broad range of topics relevant to environmental sustainability. These provide alternatives to the generic FGW2S used in Stage 1, for individuals to share relevant information and contribute other resources. Many are mostly focussed on specific areas of interest and varied in the types and forms of information used, but are not comprehensive; that is, they each individually do not incorporate all the subject matter and processes relevant to environmental sustainability within a single GeoWeb 2.0 platform. A good example is the Atlas of Living Australia (ALA) (Australia 2011a).

I assumed the existence of these Australian environmental GeoWeb 2 platforms was a response to Web 2.0 and that they would exhibit its characteristics, including openness. While the Atlas of Living Australia incorporates the Web 2.0 paradigm of two-way information flow, is an excellent example of interagency collaboration, and has broad national geographical application, it is relatively narrowly focussed in its subject domain of biodiversity. University-based initiatives including RedMap (IMAS 2010) and FeralScan (IACRC 2011a) also incorporate Web 2.0 interactive capabilities and are similarly focussed on a single subject. As well as a narrow subject domain of the environmental portals, I found what and how information could be volunteered, was strictly controlled. This limited my role to that of data provider, and the existence of separate subject-matter portals fragmented my information.

It is at this time Haklay (2011) begins to develop a typology of Citizen Cyberscience that, by drawing parallels with PGIS, focuses on the level of participation, with increasing levels of engagement of human cognition:

Level 1 Crowdsourcing: Citizens as Sensors, Volunteered computing

Level 2 Distributed Intelligence: Citizens as basic interpreters, Volunteer thinking.

Level 3 Participatory Science: Participation in problem definition and data collection – community science

Level 4 Extreme Citizen Science: Collaborative Science – problem definition, data collection and analysis

Using this typology, the Australian Citizen Cyberscience initiatives I reviewed position participants mostly at Level 1 and sometimes 2.

6.2 Factors affecting participation

In total, over Stage 1, 25 direct invitations were sent out from the SoOE Wiki. There were 18 registrations, 2 of which were mine, and 9 had no response. Over 40 additional people were informed of the wiki via emails and through the update reports, but no requests to be invited eventuated from these. Online participation appeared to be strongly influenced by my behaviour and declined with my decrease in activity and invitations. The SoOE did not become self-sustaining beyond my activity. Out of the people who collaborated online, one person did so substantially, two others made minor edits, and the rest were viewers only. Most additions of sites to the SoOE Map were made by the main collaborator (that they later deleted) together with other comments. The two others contributed a few sites and comments. It is noted that I did not know who the viewers of the online applications were, but they numbered more than the total of those registered online and those I interacted with offline.

There are various ways of interpreting the level and type of participation. It is possible that I did not seek enough participants. Howe (2008) described in his 10 rules for crowdsourcing the optimum size as a user base of around 5000 people with an interest or expertise in the subject matter. De Longueville (2010, p.307) concluded that “only a full scale test of the implementation of a community-based geoportal will be wholly informative”. As an individual I doubt that I could have achieved a considerably larger project, and hence the resources of a larger group would be required. Shirky’s (2008, p.264) assertion that a crowdsourcing project must be valuable to small tightly clustered groups suggests that as well as the overall size of the group, consideration must be given to the degree of internal consistency within sub-groups.

Mooney and Corcoran (2012) found that in OpenStreetMap, 87% of contributions and or edits to objects classified as heavily edited (with more than 15 edits) were performed by 11% of the total 4128 contributors. Brown and Kyttä (2014, p.133) however, noted that low participation rates are the norm: “internet-based PPGIS response rates with random household sampling have averaged 13% across five studies”. Anderson, Brossard et al. (2014) attribute people’s difficulties in online interactions to their recent development; people have not yet learnt how to communicate well online where many of the non-verbal cues that aid in communication are absent. Low participation rates are not unusual, few participants make most of the contributions

and rates vary considerably, probably due to context, hence offline information on reasons for participation and non-participation is useful. Broad-based community participation and environmental information sharing was also not reported for other individual GeoWeb 2.0 applications.

The attempts to gain online participation stimulated substantial offline participation, with 66 people interacting by email, telephone, and face-to-face. The latter were conducted one-to-one and in groups, privately and in public, planned and serendipitously. During this time participants discussed and referred a broad range of information and other resources they considered relevant to the research topic. This participation highlights the importance in researching online activities to be open to people sharing relevant information in ways other than the online options. Most importantly, participants communicated offline a variety of reasons for their reluctance to participate online.

Maintaining a stance of openness had unintended implications for participation. How the goal of environmental sustainability was to be achieved through online sharing of information was not seen as clear, or achievable in the short term. In contrast, a key collaborator reported in a face to face meeting being motivated by immediate, focussed concerns achievable in the short-term with strong leadership and clear goals. The overall topic of environmental sustainability was too broad for participants to engage, highlighting a tension between being too open, or too narrow and excluding people. A more defined focus on one environmental subject could have engendered greater participation. The requirement for initiatives to not be too broadly defined is reflected in the proliferation of environmental platforms focussed on specific issues. Taken together this supports claims (Kavouras & Kokla 2011; Warren 2011) the ability of GeoWeb 2.0 to support multiple interpretations and representations is one of its strengths. More comprehensive environmental GeoWeb 2.0 applications that support holistic integration could then be developed from the amalgamation of these separate, focussed initiatives, given suitable interoperability amongst individual platforms. The openness of the research was, however, effective in eliciting the broad and multiple conceptualisations of GeoWeb 2.0. This highlights how assuming a priori knowledge amongst participants may affect responses to research questions using terminology that are variously defined and evolving.

My own online participation was influenced by the resources available including access, equipment, expertise, money, time and motivation. The latter was influenced by a desire to investigate the research subject matter and then ethical concerns regarding my role in

facilitation and encouraging participation. Significantly, although I aimed not to overly influence potential participants or persuade them, this was unavoidable. I knew all but one participant prior to their registration on the SoOE. A direct comment was made by an online participant, Jim, that I was the major influence on what they did. The sites submitted to the SoOE Map were similar to those created by myself in subject matter and type of information. The influence of leadership qualifies ideas such as those expressed by Starbird and Palen (2011) that GeoWeb 2.0 facilitates self-organisation. Where conscious human agents are involved, talk of self-organisation belies the role of purposeful action and leadership and the factors that influence this. Also, how people behave in different context deserves examination: Starbird and Palen's (2011) work focussed on disasters, a very different situation to non-urgent ongoing environmental management.

Adopting the Web 2.0 stance of "worse is better" may have had unintended consequences for participation. Originally, making the examples perfect, complete or polished was thought to have presented the project as potentially too professional or exclusive for others to participate. It also provided the possibility for others to participate by correcting and improving. Hence, I presented the SoOE FGW2S not as polished and slick, but more grassroots and homemade. Comments about the appearance of aspects such as the icons suggest this could also have mediated against participation, where the SoOE was perceived as "not good enough".

An important aspect of Web 2.0 is the network effect in which the "power" of the system increases as the number of participants within the network grows (Anderson 2012). My role within the SoOE became as a single control point, negating the potential for the network effect to eventuate. While this was not the original intention, with the SoOE wiki chosen to allow peer-to-peer communications, these did not eventuate. Rather most communications were from participants to myself, a hierarchical, one-to-many mode rather than a networked many-to-many mode. The use of an existing social networking service may have been more familiar to participants and hence effective in allowing peer to peer communication to happen.

In addition to the technical and social barriers identified above, Stage 1 identified structural barriers. The institutional initiatives reviewed only allowed the volunteering of specific types of information in pre-defined formats. Hence, how Geoportals are structured – what Anderson (2012) calls the architecture of participation – influences how people can participate. They must align with the platform creator's views on what is important, their worldview, and how it should be represented. Also, the tendency to share information and the ability to reuse it relies

partly upon the existence of intellectual property licensing arrangements such as Creative commons. Significantly, Creative commons was introduced into Australia several years later than in the USA (Fitzgerald & Hooper 2011). Gruen (2012) described the later adoption in Australia of Freedom of Information legislation, the precursor to creative commons. Fitzgerald and Hooper (2011) also noted how Australian retailers were slow in responding to the opportunities and threats of online retailing. A trend of time delays in the recognition of GeoWeb 2.0 related developments is also noticeable in the literature. O'Reilly's (2005) reference to creative commons is offhand, and at first Anderson (2007) does not mention creative commons, then later (2012, p.65) writes that it was "just starting to appear in 2005". I explore more in Chapter 9 how other aspects of GeoWeb 2.0, such as VGI, Neogeography and Crowdsourcing also appear later in the Australian literature.

Overall, while the FGW2S used and other environmental GeoWeb 2.0 applications identified in Stage 1 allow community based environmental information sharing, the level of participation cannot be said to be broad-based, and many barriers to achieving broad-based community environmental information sharing were identified.

6.3 Value of GeoWeb 2.0 use for environmental sustainability

The experience of Stage 1 demonstrated that diverse information creation, sharing and collaboration are possible for individuals using FGW2S, supporting claims GeoWeb 2.0 contributes to the democratisation of information creation. Warf and Sui (2010) argue democratisation arises from Neogeography's ability to support multiple ontologies and epistemologies both following and influencing post-modernist thought. This development moves GIS beyond a traditional focus on a positivist world view and the correspondence version of truth. For example, Neogeography can encompass constructivist and hermeneutic ontologies and consensus and performative, relational and relative versions of truth. Manifestations of this broadening focus include affective / emotional GIS, feminist GIS, ethnographic and indigenous knowledge and humanistic GIScience (Warf & Sui 2010). This can fundamentally challenge the way knowledge is constructed from being predominantly by experts, such as scientists, for non-experts, to collaboratively constructed by experts and non-experts together. GeoWeb 2.0 can allow non-experts such as citizen scientists to interact with data, information and knowledge created by experts and scientists to add to it, but also

importantly to question ontological and epistemological assumptions about what is important and how it is presented, and create alternative representations and interpretations.

My personal action described in Stage 1 demonstrated opportunities for crowdsourcing environmental action similar to that harnessed by the civic initiative adopt-a-hydrant (Code for America 2011). The development of similar apps in Australia such as Snap-Send-Solve (Outware Media 2011) and VandalTrak (VandalTrak 2011) seek to access crowdsourced information, but are yet to extend to supporting action. The potential for the GeoWeb 2.0 to engage community members to VGI is explored through a plethora of other online platforms and mobile apps in disciplines such as citizen science, planning, advocacy, and community action. Many are mainly focussed at improving the efficiency of existing activities, while alternatives such as Coal Seam Gas Map and Local Harvest demonstrate the potential to support alternative views. For environmental sustainability, this presents the possibility to move away from the struggle for one monolithic version, developed and enacted from the top down, to multiple versions, relative and relational views that are nuanced and fluid, reflecting local social and geographical context, developed and implemented from the bottom up. Important in supporting this is the variety of FGW2S that support many ways of presenting information.

However, which Web 2.0 components are incorporated into FGW2S to create “open architectures of participation” depends upon the perspective of those who build and control them. An example that illustrates this is whether information is organised through taxonomies or folksonomies. Whether a taxonomic or folksonomic approach to classification is considered best depends partly upon the ontology or world view held (Lau 2008). A positivist scientific ontology that considers there to be a “best” description of reality would seek to create taxonomy by those deemed as the most appropriate experts or authorities. A constructivist worldview would see folksonomy as reflecting the diversity of ways reality can be described (Warf & Sui 2010). User tagging to create layers and the attached table of contents, such as in Wikimapia, can reflect a greater diversity of ways phenomena are described (Bishr & Kuhn 2007). There are ethical implications from both. Taxonomy can be seen as more autocratic and exclusive (Lau 2008), while a folksonomy is potentially wrong, or unworkable.

The difference is not that simple. Taxonomies can be developed collaboratively, and folksonomies can be exclusive of those who do not use or understand tagging. An optimum approach could incorporate both, as appropriate, such as where a folksonomy suggests options

from existing taxonomies, or taxonomies employ folksonomy to investigate alternative classifications (Bishr & Kuhn 2007; Kalantari, Olfat & Rajabifard 2010). As an example, ArcGIS has begun employing user tagging to allow a more user friendly method of creating metadata (ESRI 2014; Mooney & Corcoran 2011). The capability to use folksonomy for layer definitions was not discovered in a FGW2S, other than Wikimapia, during this research. This reflects how technology constructs architectures of participation that are open in different ways, affecting the power to express different world views.

Claims of the transformative power of GeoWeb 2.0 and the democratisation of information, rest on its supposed openness and ease of use lowering the barriers to participation for more people. Initially I accepted these claims, and was enthusiastic about the potential. However, throughout Stage 1 I was forced to re-examine these claims as instances of technical difficulties challenged ease of use. Ease of use is of course a relative concept, but it was asserted to apply to most people who did not have particular expertise such as programming ability. Further, other GeoWeb 2.0 platforms were structured in ways that challenged claims of openness. They limited what information could be volunteered and how that information was structured.

These experiences add to and qualify an overly simplistic or optimistic view of GeoWeb 2.0 as predominantly open and a democratising force. While FGW2S make it easy to create and share, the difficulties encountered show that barriers still exist. Those with greater expertise and resources have an advantage in overcoming these barriers and hence potential to create and maintain a presence on the internet. Motivation and attitude were identified as adding to or countering greater expertise and resources. The constant change and development of FGW2S suggests that the gaining of specialist expertise entails the risk of redundancy, with the investment in this expertise becoming a sunk cost. The list of reasons communicated to not participate online also shows why the democratising capability may not be utilised. Many are new emergent properties of Web 2.0 and participating online that mediate against the democratising potential.

Allenby and Sarewitz (2011) illustrate how emergent properties of complex adaptive systems such as technology necessitate assessment at multiple levels. Most assessments of the benefits of technology are done within a restricted context, what they call Level I use. At this level, cause and effect are usually direct and may be complicated but are not complex. An example of a level I use is how aircraft make travel from point A to B faster. As Level I use increases, there are emergent Level II and III outcomes that qualify the benefits of Level I use. Many

people using aircraft creates the need for a travel management system at Level II, reducing the original efficiency gains at Level I. Level III effects of aircraft and transportation systems include military and economic domination, global trade, spread of diseases and pollution. Macnamara (2010) illustrated how technological advances are often accompanied by new demands and problems, with the example of domestic appliances such as the washing machine that was accompanied by an increased demand for clean clothes, while also isolating housewives as other help was no longer required. Level II and III effects are complex, often chaotic and unpredictable.

My use of GeoWeb 2.0 to address water conservation and weeds were examples of Level I efficiencies gained from lower transaction costs. An example in this context of Level II effects is how privacy and security concerns from online activities and open information then became a barrier to participation. Another response at level II such as restrictions and governance requirements can then in turn further increase transactions costs. Other level II and III effects include the diversion of resources, disruptions to existing organisations, fragmentation and duplication of (personal) information, and the loss of authority and rationale for existing organisations and employees. These constitute new emergent transaction costs arising from change, openness and attendant disruption. It is, therefore, problematical to assume that the extension of activities such as my own will necessarily improve environmental sustainability at broader scales.

6.4 Changing worldview and approach

This section reflects upon methodology with respect to the wider criteria for quality established in section 3.2.1. As this involved my own participation, it is largely written in the first person. I begin with my worldview and how it changed.

At the commencement of this research I was predominantly of a neo-positivist³⁰ worldview and the research began as a mixture of qualitative and quantitative approaches. Important then were objective scientific descriptions of the world “out there”, as well as human values that attributed meaning to this world. In early writings, I asserted that information supporting sustainable environmental management should cover both. This view reflected a fundamental

³⁰ A later phase of the positivist worldview, in which an objective reality is thought to exist and can only be described through experience and empirical analysis. Social reality is then best described by application of the scientific methodology, not through metaphysical and subjective arguments.

commitment to the separation of these two phenomena, and information about them (Dowling 2010; Law 2004; Mansvelt & Berg 2010). Through this research my ontological view has become more pluralistic with an appreciation for the potential validity of different world-views and the relationship between values and facts (Putnam 2002). The change in my ontological perspective was brought about by the research process and this is fundamental to the quality of the research (Waite 2010). This is not to reject the validity of the scientific method, but rather any hegemonic claims for its methodological privilege.

While I still experience a singular reality that is out there and appears anterior to this experience, I admit there are many possible representations of this world, and that there is not one complete perfect representation (Coucletis 2002; Pollack 2005). This would be another version of the world. This view incorporates a scientific methodology as best for certain purposes – providing an explanation that “works” (Allen et al. 2001).³¹ In this, what “works” is not value free, and in the Western view this is most often tied up with notions of efficiency, economy and control (Davison 2001; Flood 2010). Pirsig (1974) interrogated this view to pull apart what works as not only being perhaps the fastest, least costly route to a destination, as sometimes more importantly the most interesting, enjoyable – or, in this context, environmentally sustainable route. Quercia, Schifanella et al. (2014) demonstrate how alternative values can be incorporated within GeoWeb 2.0 technologies to create “happy maps” . The most economical use of time is not always the same as the best.

As the research progressed I became more concerned with the relationship between values and facts, how values influence what we determine are called facts (Pirsig 1991; Putnam 2002). This comes from our choice of method, which arise from our values based on a particular ontological view of the world. We do not observe the world objectively from some ultimate vantage point. Instead, we are all situated in time and space, embodied within ourselves and what we see is determined by this position (Mansvelt & Berg 2010; Waite 2010). As well as the influence of our embodiment (Kahneman 2011), what it is possible to represent as facts is influenced by what Law (2004) calls the hinterland that surrounds us, that favours a particular world view, and is extremely difficult to step beyond. This hinterland is similar to Harris’ (2007) contingent history, how in relation to sustainability, “... the present situation has deep

³¹ Not for the billions of people without adequate education, who know little of western science.

historical and contingent roots” and “there are huge sunk costs ... we are hedged about by ... culture, community, capitals, constraints, complexity, connectivity and context” (p. 6).

The influence of place on method includes what is known and visible at a certain time and place. A strong influence on what was discovered was the initial conceptualisation of the ICT revolution as Web 2.0, and the predominant focus of the University of Tasmania School of Geography and Environmental Studies on the technical aspects of Geographic Information Science and Systems, surveying, remote sensing and geodesy applied mostly to physical phenomenon through a positivist lens. Throughout Stage 1, I discovered the disciplines of and literature on GIS and Society, Critical GIS and Public Participation GIS, describing developments in GeoWeb 2.0 from alternative perspectives. This led to an appreciation and wider understanding of the various disciplinary perspectives and terminology under which developments were described. Much of this was due to referrals from participants that contained threads of ideas and other clues, prompting searches in new directions. It was also a natural consequence of time researching and time for other literature to be published; some resources were available when I started but undiscovered, while others were not yet published or created.

This change in ontological perspective was influenced by what was encountered and influenced the research methodology. Towards the end of Stage 1 a difference was apparent between the PAR methodology I set out to implement and what was achieved. Participation and collaboration did not happen how I had planned, with very few contributions to the online platforms. The online platforms were viewed and, as I used them to communicate my work, my online participation was significant. However, most of the participation by others was offline in personal conversations, emails, and meetings. As well as those registered on the SoOE platforms, additional participants provided feedback on my work through the course of everyday interactions. Often this was unexpected and unbidden, yet still insightful, either through what was said or because of who said it.

My application of PAR did not match Kemmis and McTaggart’s (2005) description of Communicative Action and Public Sphere in which participants shared equally in the direction of the research. Moving community participants beyond being merely the subjects of the research to actively contributing, collaborating, and ultimately assisting in direction of the research, required more sensitivity than I originally thought, or was led to believe by the Web 2.0 literature. While I requested participants provide direction on my web site, I received no

explicit statements of direction. I learnt to read this from what participants discussed and did, interpreting these as implicit directions. This is similar to how Web 2.0 companies develop applications based on what people actually pay attention to and use, as implicit feedback on what is considered important (Anderson 2012).

The experience of Stage 1 highlighted the unavoidability of the influence of my actions on participation. Kemmis and McTaggart (2005) relate how their perspective on the researcher role in PAR developed from an initial perspective of an independent facilitator, to acknowledgement of how such independence is not possible. This is consistent with the ontological perspective of qualitative research that rejects the possibility of research objectivity or neutrality, but raises important questions of how the researcher should represent themselves. In Action Research, with an emphasis on emancipatory outcomes, ethics must be a strong determinant of how this is done, and hence attention to the well-being of potential participants is essential. The research experiences and literature on developments in GeoWeb 2.0 tempered my initial predominantly positive perspective and enthusiasm. The complexity of contributing factors posed possibilities for unintended negative outcomes, and hence I was more circumspect about encouraging participation and the volunteering of information in online contexts based on proposed positive outcomes. The influence of larger scale and external factors on participation such as privacy and security concerns, were then emergent ethical and practical determinants of methodology.

This reveals an important distinction in the value orientation of PAR and the Web 2.0 mode of Engage and Co-create which at the outset of this research were thought similar. The actions of leaders of commercial initiatives directed by profit making considerations are less concerned with equal direction by participants and more concerned with how participation adds value to their enterprise. That the participants also gain benefit is a collateral outcome and not a central aim. Engaging participants equally in PAR involves balancing being encouraging and attractive, not too perfect, while also responsible and ethical. This is the tension between delighting people and good governance evident in the presentations to the OAIC described in PAR 6. As Denniss (2011) pointed out, commercial ventures have fewer constraints on truth-telling, or how they represent the truth evenly. It is hard to reconcile the types of behaviour acceptable within commercial contexts with that used in research using the PAR methodology which seeks to achieve more equal leadership within its participants. I could not resolve the

tensions between encouraging participation, managing ethical issues and not overly influencing participants. For this, relationship building is essential and takes time and patience.

Importantly, ethical concerns necessitated learning how to interpret non-participation. The necessity of “getting research results” constituted a temptation to be constantly pursuing participants and participation. As well as the ethical reasons for not doing so, it was thought that this would pre-determine the outcome – the result is because you lead, cajole, and convince participants to react – not because they want to. To reduce the effects of my influence on people, I tried to maintain an ambivalent attitude, to communicate the potential of the project but not to oversell or hype this, then leave them to decide how to act. This mode of behaviour does not match that described by Howe (2008) who says that successful crowdsourcing projects require a benevolent dictator who will direct and make decisions for participants, and quotes the founder of Flickr as having had to play host to the first 1000 participants. Given my influence it is possible that the way I acted militated against participation. When participants did not respond, it became part of the interpretive work to listen to these silences (Davies & Dwyer 2007; Waitt 2010).

My primary role and influence on the direction meant the actual methodology was closer to Action Research than PAR (Herr & Anderson 2005). The research methodology had moved along a continuum from the starting ideal of PAR towards Action Research in response to my changing position within the research, ethical influences and the nature of participant interaction encountered. This position also involved movement along a continuum between insider and outsider relations in different contexts. My own participation can best be described as an auto-ethnographic version of Action Research where, as an insider, I sought to understand the implications of the emerging GeoWeb 2.0 for my professional practice of using spatial information for environmental management, my life and community. The changing methodology demonstrates the sensitivity of the reflective cycles in responding to the conditions encountered, as compared to a methodological stance that pursued the initial aims and methodology regardless of what was encountered or ethical considerations. This experience agreed with Kemmis and McTaggart (2005) qualification that the recursive cycles of PAR are “not as neat ... the stages overlap and initial plans quickly become obsolete ... the process is ... more fluid, open and responsive” (p.563). Also, as Dick points out, “there are cycles within cycles within cycles (within cycles ...)” (1999, p.4).

This methodological fluidity and plurality then introduced the problem of how I can claim validity, reliability and “truthfulness”, and hence any authority for this research. In addition to the broader criteria for quality established in Chapter 3, I also aim for “thick description”, to “take the reader to the centre of ... (my) ... experience ... providing an in-depth study of the context and ... (my) ... reasons, intentions, understandings and motivations” (Mansvelt & Berg 2010, p.348). Part of this thick description are my “positionality statements” (Waitt 2010) presented in the preface, this section and throughout the thesis. These are demonstrations of my claims for ongoing critical reflexivity (Dowling 2010) as also adding to the credibility of this research. Supporting these have been my efforts to keep careful documentation of my interpretation process (Bradshaw & Stratford 2010). Much of the research documentation has also been published online throughout the process, again demonstrating openness and transparency.

Within this overall approach, there are still important questions of how to present what I found. It has not been possible to simply “write-up” the thesis, removing myself from the text, to produce the “god trick” of a view from everywhere, producing objective knowledge (Waitt 2010). Rather, it has been what Mansveld and Berg (2010) describe as a process of writing-in, for which I have used the first person, making explicit the position of construction. This transparency is offered as another means of establishing reliability, but I do not make claims for universality. I prefer Stenger’s criteria for truthfulness: that my work will attract “interest”, that it will concern the reader, “intervene in his or her life”, perhaps transform it, or they “will ask the question: can I incorporate this ‘thing’” (in Law pp 40-41).

The contribution to knowledge has been to explore the implications of GeoWeb 2.0 for broad community participation in environmental sustainability from a unique perspective, both geographical and methodological, as recommended by Elwood, Goodchild and Sui (2013). This adds to a more detailed and nuanced understanding of the situation and, as per Action Research’s outcome validity, reframing of questions and problems in a more complex way (Herr & Anderson 2005, p.55). Exposing questions and problems challenges interpretations of GeoWeb 2.0 that are partial or simplistic, claim universality, or are predominantly optimistic or pessimistic. Doing so can lead to insights and improvements in the use of GeoWeb 2.0 capabilities for sharing information supporting sustainable environmental management.

The experience of Stage 1 had shown understanding of GeoWeb 2.0 to be in its infancy in Australia, compared to North America and Europe, based on the amount and extent of literature

addressing it as a distinct phenomenon. A defining feature had appeared to be openness, primarily in allowing widespread interaction, contribution, reuse, and adaptation of spatial information and other resources, but Stage 1 experiences had challenged the idea of openness. Questions emerging from Stage 1 centred on understanding how GeoWeb 2.0 had evolved in the Australian context and might do in the future, specifically, the evolution in relation to environmental information, sustainability and the implications of “openness”.

In Stage 2, I sought interactions within existing environmentally focussed initiatives and went looking specifically for Australian research to find out how GeoWeb 2.0 was being implemented and researched. That the research participants and others in my community must also have a limited understanding led to a desire to contribute to a deeper and more nuanced understanding of GeoWeb 2.0. Part of this was also about communicating how partial knowledge is, and influenced by the position of observation. These factors motivated the publication of the paper that is part of Chapter 9.

For Stage 2 I moved away from the PAR approach in which I sought to collaborate with others to instigate change, to seek out positions from which to observe and influence change in existing applications. My methodology incorporated more elements of Ethnography as well as Participant Observation. Kozinets (2002, p.2) describes Ethnography as an “inherently open-ended practice ... based on participation and observation in particular cultural arenas as well as acknowledgement and employment of researcher reflexivity. That is, it relies heavily on the acuity of the researcher as instrument”. Burrell et al. (2004) used Ethnographic methods that included semi-structured interviews and Participant Observation to study the needs and priorities of people working in a vineyard, to gain a better understanding of the potential for sensor networks here and more broadly in agriculture. Outdoor environmental conditions are more changing and heterogeneous than office environments. Researchers of Location Based Services (LBS) consider mobile location-based decision-making by humans may be different from generic decision making (Rabaul 2011). Bilandzic and Foth (2012) combine Ethnography and Action Research with Design Theory into a hybrid approach, as methods adaptable to the fluid nature of contextual settings and for which it is difficult to design for in advance.

6.5 Ethics, informed consent and naturalistic enquiry

Ethnographic and Participant Observation approaches raised difficult ethical questions regarding how to deal with the issue of informed consent. It was not always possible to pre-

determine who may be a participant. Rather it was determined by whether the topic of interaction was relevant to the research questions. It was impossible to ask for participant consent before every interaction in case it became relevant, and it was also impractical to stop an interaction that had become significant, to ask for ethics approval. Often the fact that an interaction was significant only became apparent on later reflection, or due to subsequent knowledge or developments. I considered this type of data collection more naturalistic and resisted practice that might interfere with this. Kearns (2010) refers to how being seen to visibly observe, such as by writing notes or using a voice recorder, can interfere with activities. I hence placed more emphasis on what was freely volunteered without prompting, considering that this reflected what was most important to the individual at the time.

Christians (2005) highlighted the inadequacies of the procedures and rules used by institutional ethics committees for protecting the rights of participants in contexts that are fluid: “informed consent, mandatory before medical experiments, is simply incongruous with interpretive research that interacts with human beings in their natural settings rather than analysing human subjects in a laboratory” (Christians 2005, p.147). This implies that more contrived settings have a higher demand for informed consent, but this cannot be always assumed to be so. Throughout Stage 1, I had reflected on the ethics of observing people in settings of varying “naturalness” and using such observations as research data. The actual act of observing, listening and recording interactions I did not believe was unethical. We all do it every day, and also often record our observations in private journals and diaries. This is considered legitimate, as the observations are personal and not meant for public use. The ethical dilemma arises from the intent of the observations, such as if use of the observations contravenes the person’s rights to privacy, intellectual property, or proper representation. The problem with prescriptive procedures and rules is the ability to account for the nuances and subtleties of each participant, and the context of interaction in which observations are made. The rigidity of such an approach mediates against the ability of the research to reflect the actuality of the researched, calling into question the research validity.

The concept of a “natural” setting is paramount; as settings will always vary in “naturalness” depending on how contrived they have been for research purposes. Perhaps the only perfectly natural setting is that of covert observation where the presence and actions of the researcher are completely unknown and hence do not affect the setting. It was not the intention to ever conduct this research covertly; in fact the purpose was to be overtly seen both conducting and

participating in the research. The settings in which this research was conducted varied, from being intentionally created and conducted by myself, through to variously created and conducted by myself with research participants, to totally outside of my intentions, expectations and control. The former includes some of the research internet platforms and interview situations created, while some meetings and interactions were jointly instigated and controlled, and yet others were completely serendipitous.

Therefore, in this research, not all “natural” settings were the same, and usually entailed a set of explicit and assumed rules for interaction, which may or may not be shared by all the participants. The ethical conduct of the research then rested heavily on my acuity to be able to assess each situation’s requirements. Beaulieu and Estalella (2012) sought to document how they perform these practical judgements, invoking the term *phronesis*, the virtue of practical thought or wisdom. For transparency and as a guide I sought to elucidate some principles of *phronesis* to inform this situational assessment.

Paramount among these principles must be a respect for those participating in and affected by the research (including the researcher), such that their needs are considered as equally important if not greater, than those of the research (Dowling 2010). These needs include a respect for participant’s well-being, privacy, property including intellectual, the right to be informed, and a right to proper representation. It may not always be possible or desirable to achieve these together. The right to be informed and for proper representation, cannot always be reconciled against the need not to intrude or to contravene a person’s privacy. As observed by Beaulieu and Estalella (2012), this is sometimes especially pertinent where internet-based research is involved, as it breaks down the barriers between different research sites and creates traces that can make complete anonymity unachievable. An ongoing stance of reflexivity, whereby the researcher constantly considers the context of interaction and their position and influence within this context, has been recommended as a primary tool to aid and facilitate the assessment of ethical needs (Guillemin & Gillam 2004). The following constituted the main factors I sought to consider through reflexivity:

- How does the relative power differential between researcher and researched affect the degree to which either is dependent on the other for their well-being?
- When is informed consent required for participation?
- How is informed consent to be communicated, understood, and verified?
- What and when is it appropriate to observe and record?

- What can be communicated from what is observed and recorded, and how?

Power differentials almost always exist between the researcher and the participants (Dowling 2010). Where the researcher is ascendant, careful consideration must be given to the potential for the researcher to exert undue influence, intended or otherwise. Christians (2005) identifies how “scientists carry the mantle of university based authority as they venture out into the local community to do research”. For example, in the case of using the internet, the researcher needs to be careful of the degree to which their attitudes influence use or otherwise. Conversely, where the power is otherwise, Bradshaw (2001) cautions for consideration of the ability of the more powerful to influence the research direction, outcomes or conclusion, and hence its validity.

Therefore, the ethical conduct of this research, using participant observation and ethnographic methods with multiple participants and in fluid settings, relies on my ability to assess the needs of the context. For this, a practice of reflexivity is crucial, guided by the overall principle of respect for participant’s well-being and rights. This forefronts constant questions regarding the power relationships attending interactions, when informed consent is required and how it should be obtained, what can be observed and when it is appropriate to observe, and what observations should be communicated and how.

6.6 Summary

This chapter has reviewed and synthesised the results of Stage 1 with reference to the initial research aim and objectives. Following AR’s broader quality criteria, it has also explicated how the research affected my own worldview and influenced the research methodology. These findings set the scene for the direction taken in Stage 2 and necessitated developing guidelines for practical judgements regarding ethical issues arising from the fluid nature of the research contexts. The next two chapters describe the results of Stage 2. Chapter 7 begins with an introduction to the overall rationale and approach.

Chapter 7 Stage 2: Bottom-up approaches (2012/13)

Stage 2 was informed by the ethical, practical and theoretical issues emergent through Stage 1. It involved engagements with existing environmentally focussed initiatives to further investigate how GeoWeb 2.0 could be used for sharing information related to environmental management. I engaged with groups involved in environmental management, government organisations and projects, websites and platforms; through proposals for projects, reviews of documents and online initiatives, and participation in events and programs.

The dominant shift in methodology was from a stance of actively seeking participation in the research direction (PAR) to seeking to interact with participants and observe through my own actions. The main methods used in this stage were informed more by Participant Observation and Ethnography. In most of these contexts my position varied from insider and leader of action, to an outsider or follower of action. Throughout Stage 2 the SoOE Wiki and Maps were kept broad and open mainly for my own practice and demonstrations.

I have grouped these engagements broadly as bottom up and top down. The results of the bottom up interactions are set out in this Chapter (7) and the top down are in Chapter 8. The first bottom up engagement was with several community environmental groups. An engagement also occurred with BOM regarding a proposal for crowdsourcing the weather. I also presented to and gained feedback from the National State of the Environment agencies working group and participated in the Tasmanian State of the Environment (SOE) reporting review. The web presence of the South Hobart Sustainable community represented an interesting bottom up initiative and I interviewed its creator. Western Australia's opening of mining environmental plans was explored and I participated in GovHack2013, a national event challenging participants to use open data. Social media workshops run as part of the National Broadband Network and Landcare provided additional insights.

Other engagements were discussions and interviews with developers of the RedMap platform, discussions and a project proposal with the regional natural resource management organisation, NRM South, and with the developers of the platform Local Harvest. While descriptions of these have not been included for the sake of space, pertinent perspectives are included.

7.1 Community environmental groups

Early in 2012 I began exploring with several local environmental community groups how they might use FGW2S to support their activities. A proposal was developed and advertised in several newsletters. The initial generic proposal was uploaded to the SoOE wiki.³² The invitation proposed that GeoWeb 2.0 could be used to store, display and communicate the group's area of interest and activities, including the environmental values the group was seeking to protect; threats to those environmental values; and the location of group activities managing the values and threats. It was expected this would provide the following benefits to the groups:

- a repository for information relevant to the group as people come and go
- a means to communicate to stakeholders the group interests and activities, such as to the Local Council, the state Parks and Wildlife Service, and Government environmental programs
- a means of sharing and connecting with similar groups and
- a vehicle for attracting a younger generation of “digital natives” to Landcare and Coastcare.

I met with two Landcare and Coastcare groups and I identify them here as Group A and B. Group A was contacted directly, as I had previously worked with group members. They were interested in the research but expressed reticence about the value to the group for two main reasons. Firstly, they considered most of their objectives had been achieved and hence were not sure how GeoWeb 2.0 could be applied. Secondly, many of the members were older with a low level of technology literacy; email was the most advanced use of technology in many cases. They agreed that it could be useful as a repository of their work, with a comment that described the FGW2S as a type of “electronic billboard”. To this end I created a Google My Map³³ and Wiki³⁴ for the groups and invited all members to contribute. Only two members responded. One member placed a point on the map, the other supplied photographs offline that I used on the wiki. Beyond the low level of collaboration, the two most interesting aspects about this engagement was feedback from a key informant and subsequent use of the technology by two other group members. In response to my direct question, “What influences you to contribute to the web site”, a key group member answered “the researcher”. Despite

³² <http://stateofourenvironment.wikispaces.com/file/detail/Proposal+for+Land-Coast+Care+Groups+to+participate+in+UTAS+PhD+Research+project.docxt>, added 24 Jul 2012

³³ <https://www.google.com/maps/d/edit?mid=zxgywoUIFChE.k8Thseuf0xQI>

³⁴ <https://rosebaycoastcare.wikispaces.com/>

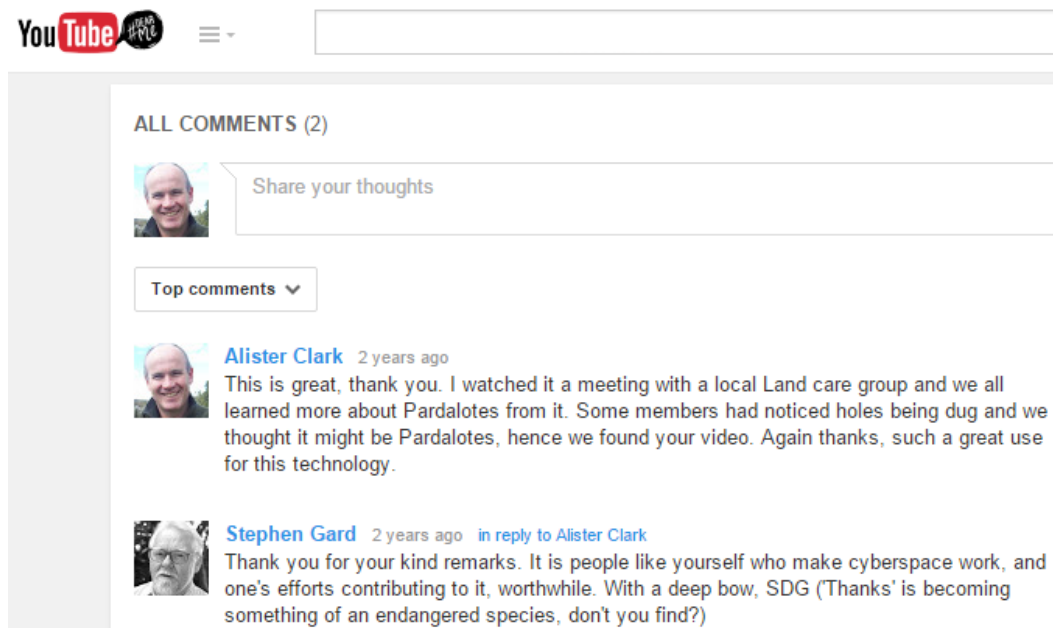
efforts to downplay my position as a leader, I was still positioned in this way, showing my inevitable influence on the outcomes. This reinforces the experiences of Stage 1 that leadership is important in such endeavours.

The other interesting outcome was the subsequent use by two key members of FGW2S to publicise and gain funding for an unrelated social enterprise. Their use included a social networking application (Facebook), a GeoWeb application (Animaps), a blog (Wordpress), Photo sharing site (Flickr) and Google forms. They used the FGW2S to interact with friends and supporters in narrative, conversations, photos and spatial representations. While these applications were all independent, they could integrate and link them to present a unified perspective. Using these applications allowed them to publicise activities, gain funding and other support such as feedback through comments and “likes”, and keep interested persons up to date through syndication. While most of the community group’s work had been accomplished and its use was not clear, personal ownership of the social enterprise provided strong motivation. This echoes a comment by another collaborator (Connor) who was motivated to contribute to the Standby Taskforce because the purpose was clear, immediate and of short duration. My assistance for the charity rally was sought early on, but my contribution was very limited with most of the choices, learning and development work done independently. Significantly, both persons had leadership roles in the community group and elsewhere. The interesting insight from complexity theory is that this outcome was entirely unintended and unforeseen but also beneficial.

Group B responded via my newsletter article and I had not met or previously worked with these group members. I had an initial meeting with two key members, explained my research and we agreed to continue. Despite not having previously met this group, at the first meeting I was greeted by name which was surprisingly and unsettling. I had been recognised from my online presence, an example of how the internet breaks down barriers. A second, longer meeting was organised with other key members. At this meeting all members had computers, tablets and smart phones and, while none were “net natives”, all seemed comfortable and competent with the technology. I could display my laptop on a television screen for all to view and showed the group my wiki and map and how I thought a similar approach might be useful for the group. Everyone seemed excited by the possibilities and wanted to progress. An interesting experience through the process was the use of the technology for in-situ group or social collaborative learning opportunities. A discussion arose regarding what animal had been digging holes

observed in the bush. The holes in question were thought too big for Brown bandicoots and one group member suggested Pardalotes, unfamiliar to some of the others. A quick search of the internet revealed a video on YouTube of a Pardalote digging a burrow (Gard 2011), which the group watched and appreciated. I later used the YouTube comments to thank the video creator and his reply was gratifying (Figure 7-1).

Figure 7-1: Comments on Youtube pardalote video viewed at Landcare group meeting



(Source: Gard 2011)

The meeting concluded with the group agreeing to consider their approach. I wrote up my notes of the meeting and sent them to the group. As these were private meetings they were not uploaded to the SoOE Wiki. Unfortunately, although the group seemed keen and excited to continue that was the last meeting I had with them. I corresponded via email several times but was told they did not have time to continue. I am unable to determine if lack of time is the main barrier to adoption here or other factors.

All Landcare groups showed initial interest that did not translate into any substantial related action. There was a distinct variation in the motivation level of the groups, from very motivated to not motivated. Time constraints were given as the reason the motivated group did not participate with concrete action. The demographic of the community groups was overwhelmingly older, predominantly digital immigrants, with computer and internet literacy levels from very literate and comfortable to not literate. As noted above, I know that some of

the literate members from the low motivation group subsequently successfully used FGW2S for different purposes. Some responses suggest the level of participation related to my actions and leadership. As discussed in the methods, I did not seek to persuade or encourage action either way. I did not try to predetermine how they should use the FGW2S except in general terms, or do too much other than provide a start with some examples.

My experience with the groups shows that motivation, time, literacy and leadership are all important components influencing use, that the presence of one alone did not lead to action, suggesting that probably all need to be present together. To supplement this experience, I looked for local community groups already using FGW2S to share environmental information, with the South Hobart Sustainable community group a particularly interesting example, described in 7.4.

7.2 Crowdsourcing the weather

Early in 2012, a series of conversations were conducted with senior personnel at BOM about using GeoWeb 2.0 for crowdsourcing weather information. From these conversations, I developed a proposal in April 2012³⁵ to collaborate with BOM on research into how crowdsourcing the weather could be undertaken. The proposal was further developed after BOM personnel provided feedback in areas of concern and avenues for exploration. The revised proposal “Crowdsourcing the weather part 2 – engaging weather volunteers in co-creating weather information” incorporated this feedback and elaborated a more specific weather crowdsourcing proposal. While the proposal developed during this research, the process revealed insights into BOM and the attitude of key personnel towards crowdsourcing.

The concept of crowdsourcing the weather was not entirely new to BOM as they already had volunteers collecting weather information as cooperative observers and Storm Spotters (BOM 2012). Evidence collected by the Storm Spotters and cooperative observers is useful after an event by providing tangible evidence of the actual impacts of the storms, and this greatly assists learning by the forecasters.

The crowdsourcing research proposal summarised the concepts of crowdsourcing, volunteered geographic information and humans acting as sensors. It described the burgeoning interest in

³⁵ Attached to the SOE Wiki 24 July 2012:

<http://stateofourevironment.wikispaces.com/file/detail/Crowdsourcing+the+weather+part+2.docx>

the potential of these technologies and practices for environmental applications. Humans could act as mobile intelligent sensors that understand abstract concepts such as purpose and objectives, are self-organising and adaptable and hence can collect information in real time from unexpected places and in unexpected circumstances and ways. Volunteers represented a powerful opportunity to collect weather related information to augment traditional technology such as weather stations, flow meters and other sensors. An example cited by BOM personnel (BOM 2011) was that in the 2011 Queensland floods the most intense rainfall was unrecorded by the weather station network and they thought that a volunteer may have been able to record the event if on site and empowered.

One of the primary areas of concern for BOM was “what” information volunteers would provide and the likelihood that it would be difficult to aggregate if different in its syntactical and semantic expression. BOM’s recent experience in providing a national water information service revealed that semantic mediation of the data from all of the disparate regional water agencies was extremely difficult and resource intensive (Vertessy 2011). Opening information collection to a potentially more heterogeneous group in an uncontrolled way posed a risk of creating an even greater resourcing burden.

Developing and refining the proposal revealed important aspects about BOM organisational and senior personnel attitude to use of GeoWeb 2.0 to support crowdsourcing of weather information. BOM’s volunteer programs of cooperative observers and Storm Spotters demonstrated an existing openness to the value of wider community (non-expert) contributions. A significant comment from the then Assistant Director of BOM during an email conversation was “*I know there is something in this but not sure what*”. I interpret this as openness to the concept but with insufficient understanding to decide on the appropriate action. Senior leadership attitudes were also essential and, while this may seem self-evident, it provides another perspective on the concept of self-organisation in complex adaptive systems. Self-organisation does not account for the reasons behind the purposeful actions of conscious agents.

I surmise that the reasons the proposal was not progressed include my position as an outsider, the nature of the proposal, and BOM resources. Although I had an inside contact with BOM and had met key personnel, as an outsider I was unable to maintain and develop relationships. On reflection and with hindsight, many problems are now visible with the proposal that may have influenced BOM to view the proposal as naïve or too risky to commit resources. That the

proposal concept was not entirely unrealistic is demonstrated by BOM's subsequent cooperation with an existing initiative.

In 2013 BOM implemented a “crowdsourcing the weather” project through an existing United Kingdom initiative (Larkins & Lamond 2014) called the Weather Observation Website (WOW) (BOM and Met Office 2013). It is not known if this was related to the proposals developed through my research. The UK initiative was started in 2011, but I was unaware of this at the time of developing the proposal and it was not mentioned during my interactions with BOM. This later implementation suggests the proposal was not a priority at the time and/or was not the preferred method of approach. Proceeding with an established program run by a well-resourced and reputable organisation represents a sensible low risk approach. It does also suggest Australia lags the UK in this area.

I registered with WOW, submitted an observation and found it to be aligned with the characteristics intended in the proposal, such as simplicity of interface and openness in terms of the information that can be volunteered, but also with significant additional technical sophistication. In 2015, BOM also began integrating Twitter feeds into their in-house weather forecasting interfaces, and planning was underway to display their geo-location within the interface.

7.3 State of the Environment reviews

On 16 November 2012, I gave a presentation to a National SOE review group that comprised nine representatives from National and State SOE reporting initiatives. The presentation was entitled “SotE or SoOE” (State of the Environment or State of Our Environment) to highlight a fundamental difference between the existing mode of constructing SOE reports from the top down by experts, to a mode posited in the presentation of from bottom up and collaborative.

GeoWeb 2.0 was introduced, how it was changing the way information was created and shared, and the positive and negative outcomes. This was followed by an overview of some Australian applications as described in Stage 1, summarising the range of subject matter, and different architectures with accompanying degrees of openness and control. It was then posited that these capabilities and developments afforded the following opportunities for SOE reporting:

- access to a greater range of data and information
- the ability to construct SOE reports more collaboratively

- that geography could integrate information across subjects and domains
- reporting could be “live” and continuously updated and
- that bias could be made more transparent by showing the context of information creation.

This was qualified with the following issues for such a SotE. A mix of socio-technological expertise and resources are required for implementation. Such a bottom up approach can challenge current organisational culture – authority, control, and the mode of operation – a change from plan and control, to engage, co-create and guide is required. There are considerable risks of unintentional consequences, both positive and negative. The field is new and very dynamic, and the state of expertise in Australia may be limited. The presentation concluded with the following assertion:

The concept of GeoWeb 2.0 as a socio-technological phenomenon is new in Australia, and is not well described in the Australian literature. Australian understanding and use of GeoWeb 2.0 is also in its infancy compared to Europe and North America. Its manifestation here is likely to be a unique reflection of the Australian context, requiring local study and communication. In this regard, geographers and the academy have an important role to play.

There is interest in its potential for environmental management, with a growing awareness and use. Understanding of GeoWeb 2.0 in my community is in its infancy. People are interested but cautious (which I think is a good thing), and they do not all find FGW2S and GeoWeb 2.0 platforms easy to use. Much important interaction regarding GeoWeb 2.0 happens outside of the internet, hence study must include these contexts.

The aim of the presentation was to raise the awareness of key SOE decision-makers to relevant developments in GeoWeb 2.0. The most significant positive feedback on the presentation was from a State SOE reporting initiative representative who extended an invitation to present to their organisation. I was unable to travel to follow up this offer. However, this demonstrated the understanding and interest of a key SOE reporting professional. There were also no critical or negative responses from this group and none said they were already aware of GeoWeb 2.0 opportunities and working with the technology, crowdsourcing or volunteered geographic information. This aligns with the later statement by Belbin (2014) that there were no other GeoWeb 2.0 based SOE initiatives besides the Antarctic initiative.

In December 2012, through to January 2013 the Tasmanian Planning Commission (TPC) conducted a review into State of the Environment (SOE) reporting in Tasmania. I organised a submission to the SOE reporting review in January 2013. As part of the review the TPC circulated an issues paper (TPC 2012) herein referred to as the TPC Issues paper. The stated goal of the review was to “ensure that future SoE (*sic*) reporting continues to be a relevant and cost effective tool for the Tasmanian government and community” (TPC 2012, p.5), and that “given the time elapsed since the last report in 2009 it was timely to review:

- the extent to which the (SOE) Report merely duplicates information available elsewhere and data provided through other reporting mechanisms
- the effectiveness of the Report format and outputs in meeting its intended purpose
- whether there is a more cost effective way to deliver a report which still meets the legislative purpose and
- whether the TPC is best placed to deliver the Report, given its purpose” (p2).

The TPC Issues Paper provided an overview of SOE reporting in Tasmania, listing the issues with the reports for 1997 (p4), 2003 (p5) and 2009 (p6). The report identified barriers to SOE reporting as:

- inadequate funding
- ongoing availability of key data sets, many of which are not maintained over the long term
- presenting information in a manner which is too scientific and too difficult for most readers to understand
- presenting information in a manner which is of value to policy makers
- lack of meaningful or useful bench-marks
- silo mentalities
- lack of alignment between Australian SOE reporting jurisdictions, mainly due to varying legislative requirements and
- a disconnect between policy and research.

The TPC Issues paper cited several previous reviews that acknowledge many of these issues are not unique to Tasmanian SOE reporting, and that also list additional issues. Macintosh and Wilkinson’s (2006) review was not cited within the TPC Issues paper.

Several presentations and consultations were conducted by the TPC including at the University of Tasmania, in which I participated using PO and ethnographic methods, collecting data in my journal. During the consultations, previous contributors to SOE reports described how volunteer (academic) contributions to the SOE were mediated by Government and sanitised of

content and viewpoints that were not “good news”. The TPC Issues paper refers to the difficulties of accommodating different contributions in the discussion of issues with the 1997 report. Attendees at the review said this resulted in a lack of commitment to the process, decreasing the motivation for further contributions where it is perceived these may be disregarded. Essentially, the control of the SOE process by Government allows political considerations and viewpoints to mediate what is published within the SOE. I assert that this is a function of the top down creation process of the SOE, and such a process is susceptible to the mediation and bias of those in control unless very strong governance and auditing is in place to ensure independence. Feedback also included questions regarding the different themes, how the logic did not seem consistent and had overlaps; and the difficulty of creating appropriate and robust indicators. Other issues that emerged from the presentations, consultations and other reports included integrating information sources; knowing the usefulness and relevance of SOE reports; and knowing if the report cost was justified as the benefits were difficult to establish.

My submission did not address the full range of issues involved with SOE reporting, as set out in the TPC Issues paper and other reports, or raised during the consultations. It did not attempt to make suggestions about appropriate themes, indicators or reporting models but acknowledged these as important and complex problems. Rather, the approach of the submission was to consider the implications for SOE reporting of developments in information technology, particularly the evolution of GeoWeb 2.0 that represent potential opportunities to address many of these issues. As stated in the National 2011 SOE report, quoted in the TPC Issues Paper (p.5):

... collecting information is not enough. Creating and using systems that allow efficient access to environmental information remains a great national scale challenge.

The aim was also to highlight that this opportunity, however, does not come without its own set of issues and challenges and these were outlined. Regardless, it was argued that the opportunities and imperatives are such that facing these issues and challenges is warranted. Hence the submission described the developments, opportunities and issues as a first step in this process, and much of that has been incorporated in Chapters 2, 6 and 9.

7.4 South Hobart Sustainable Community group

The South Hobart Sustainable Community (SHSC) group presence on the internet (SHSC 2012) was discovered as an interesting example of community use of FGW2S for sharing information relating to environmental management. On 8 February 2013, I met with Carl, the creator of the SHSC web site who was at that stage working for Sustainable Living Tasmania (SLT). We talked about the experience, the choice of the FGW2S, what worked and didn't. In comparison, other local initiatives such as Transition Tasmania had chosen different platforms such as WISER.org. Especially relevant was the use of embedded maps, although some did not display. The notes of our meeting were recorded in my journal and sent to Carl for validation.

Carl described himself as “computer geek” at school, messing around with computers in the 1990s. He said back then it was very much a “boy thing” and thought the advent of Facebook had generated much more interest from females. Variations in gender participation rates alluded to by Carl have important implications. Stephens (2013) found in both OpenStreetMap and Google MapMaker that men are over represented as the gatekeepers of local knowledge. Due to the ubiquity of these digital basemaps, the gender bias of the creators leads to widespread reproduction of gendered content. Carl was also university educated in science. He had created the SHSC website as his contribution to efforts by SLT to create more community environmental action groups and at the time was living in a tent on a friend's place. I would characterise him as educated, computer literate and motivated by a “community good vision” rather than personal advancement. Carl's motivations align partly with those of a “serious mapper” in OpenStreetMap (Budhathoki & Haythornthwaite 2013) being very much oriented towards community learning and local knowledge but not so much career advancement.

He agreed that software was much easier to use now and the “clunkiness of MySpace” was one of the reasons for not participating when it was released. He did not participate in Facebook because of the security and privacy issues, even though he very much agreed with the open information approach. It was one of the reasons he agreed without any reservations to my interview. This contrasted with responses from institutional creators of similar web sites, who were much more closed and concerned about how they would be depicted. In our discussion on openness Carl referred to a TED presenter called Hans Rosling, a data miner, as a demonstration of the possible benefits, but lamented how many databases were often not sufficiently open. Creating the SHSC website had been mostly possible without programming

through the “drag and drop” capabilities of Google sites, but had required some simple scripting. He modelled it on a concept described as the Sharehood³⁶ with the aim to allow as many people as possible to contribute. The only cost was \$10 a year for the SHSC domain name. Originally Google had allowed 50 accounts of which 45 were initially distributed, but Google had since restricted this to 10.

Originally over 120 people had turned up to meetings of the SHSC with most of those over 50 years old, and a smaller group of 20-30 younger people. Carl said that the older people quickly dropped off. He did not know why and thought they had the time to be active. Most of the contributions were done by a much smaller group of core younger people. Carl wondered if the older people had been put off by the younger people taking over, and a colleague considered that the predominant use of email could also have been responsible. It was unknown how they used the web site or what they might have subsequently done. We talked about the use of web site analytics and Carl thought web analytics might have provided useful information. I also told him about participation rates for similar applications such as Wikipedia, to show that the SHSC experience was not unusual. I had only found out what to expect in terms of participation from other sources later, but knowing up front would have been useful. Data on participation rates tempers assumptions in GeoWeb 2.0 initiatives that people will participate and share information.

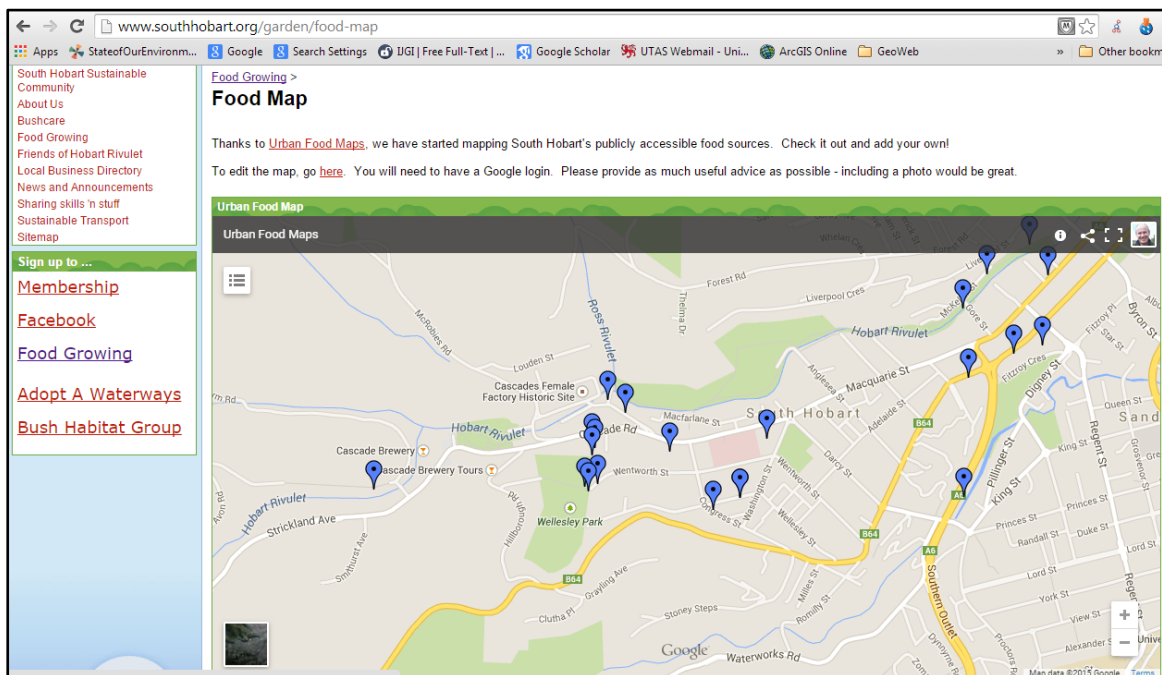
In addition to the SHSC website, meetings were held every 2 months together with other community events. Carl said these had been very important to the group. I mentioned how OpenStreetMap (OSM) organised community mapping days, but Carl was not aware of OSM. This suggested a practical outcome of this research would be to provide a wider awareness of similar and related initiatives. I used OSM as an example of how the open data movement might eventually challenge proprietary global mapping platforms such as Google Maps and Earth. In creating the SHSC they had wanted to push the envelope on what was possible. The broadness of the SHSC application was interesting; it was not as narrowly focussed as many other sites and incorporated alternative views, such as an “Urban Food Map” of South Hobart’s publicly available food resources (SHSC 2013). It demonstrated the ability of FGW2S to support alternative views on what is important and their expression, not provided by institutional initiatives. Carl used the term “Community Groupware” for applications that are also referred to as Web 2.0 or Social media. Community Groupware refers predominantly to

³⁶ <http://www.thesharehood.org/> - appears to have been taken down

open source applications that support collaboration, and is another example of divergent terminology for a fast evolving field.

At the time the Urban Food Map did not show any points identifying food sources, with the map appearing blank. I investigated and explained problems with the links and html code. When writing this I revisited the SHSC web site, the site was active and my input above had been used to correct the map (Figure 7-2).

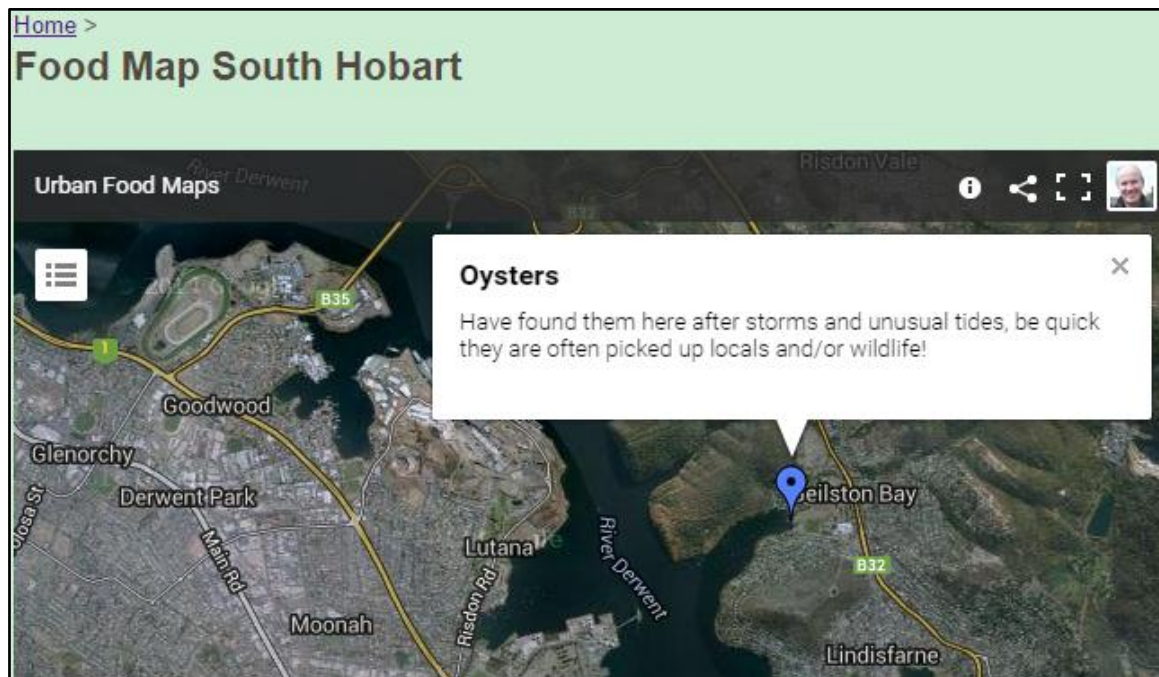
Figure 7-2: SHSC web site with corrected Food Map embedded



(Source: SHSC 2015)

The Food Map has since been incorporated into a worldwide version called Falling Fruit (Falling Fruit 2015). On a cautionary note, a site had been added listing oysters in Geilston Bay (**Error! Not a valid bookmark self-reference.**). There are public health warnings that shellfish from the River Derwent should not be consumed due to heavy metal contamination. Such information sharing can have unintended negative consequences, but also exposes deficits in community understanding, the potential for moderators and to incorporate community-based quality assurance. During writing this I added a warning to this site listing (Figure 7-4).

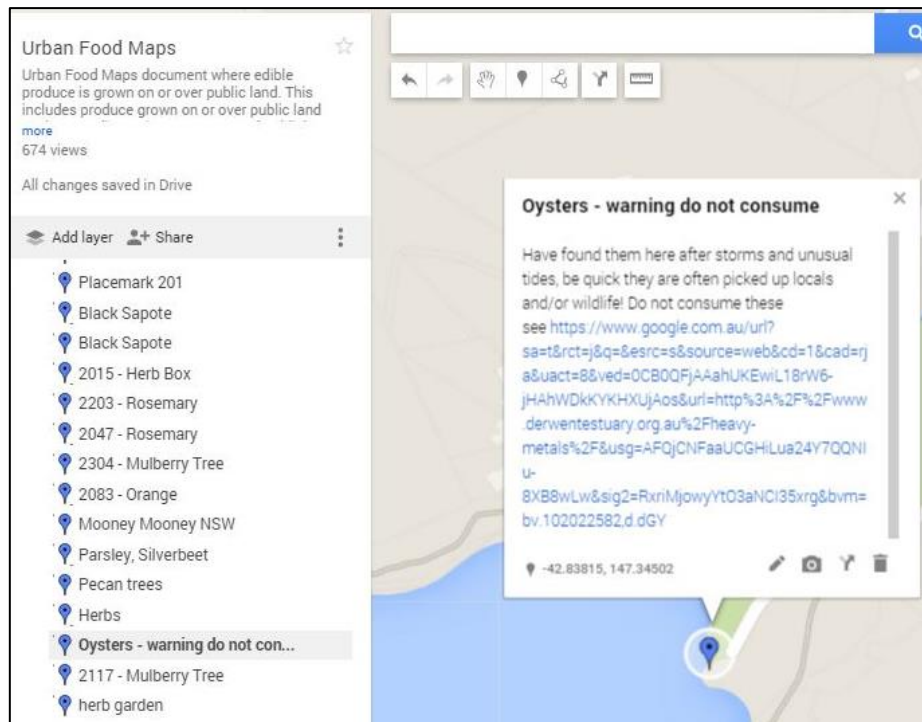
Figure 7-3: Oysters listing on Urban Food Map in area contaminated by heavy metals



(Source: SHSC 2015)

The SHSC web presence demonstrated local, grassroots use of free GeoWeb 2.0 applications to share information relating to environmental management in a way that reflects the interests of the local community. This was using a variety of mediums from web page text, attached documents, imagery, maps, spreadsheets, event planners and groups that can be linked and integrated to create a whole rich information ecosystem, for almost no cost. While the applications did not require specialist computer programming expertise, a medium level of computer literacy was required and a tertiary education level also implicated.

Figure 7-4: Warning added to Geilston Bay oysters



Most important for such a public good initiative is the motivation level of the creators. Also, a virtual presence alone is not enough to sustain the initiative as non-virtual activities are essential. Even so, sustaining engagement in the virtual presence is difficult and can rely on a few key players. It is difficult to know the reasons for or against sustained engagement. Employing web analytics or gaining feedback either online or offline might help. Online feedback can be gathered by embedding capabilities to gather ratings, comments or actual surveys. The Google Sites application allows comments but only from collaborators who are signed in. Regardless of sustained engagement, the SHSC web presence remains available and can attract and catalyse unexpected actions. Later, Carl and I discussed if Social media were a better medium for SHSC, but concluded that its temporality negated its value as a repository of the group's work. Carl's colleague Garth captured the difference in the following statement:

A website is a useful static anchor in the sea of the internet, but it is not a useful method for pushing your message out to interested people - that is where email and Social media is much more effective.

7.5 Using Western Australia's EARS

From 1 July 2013, the Western Australia (WA) government made it mandatory for mining companies to publicise their environmental plans on the WA Environmental Assessment and Regulatory System (EARS) website (WA 2013). In May 2013 I explored EARS, interested in how information was made public and its use; and the potential for an individual to use FGW2S without programming to analyse open information and publish from the bottom up. The story of my experience was provided as feedback to the WA government and published on my blog entitled “Will Australians use our EARS? Western Australia opens public access to mining company environmental plans, transparency and the crowdsourcing of environmental compliance monitoring”.³⁷

On the EARS website I was initially confused by statements that the information in both systems was only available to people “registered against a company”, but then found a link to the public access system “Access Public AERs”. A default search of “Show all” returned 48 listings, but only ten were hyperlinked to more detailed information. The first one in the list, Boral Transport Ltd’s Seven Mile Hill Mine was hyperlinked to more information and was found under headings that could be opened to reveal this information. My blog details more on how difficult it was to navigate the website, part of what Gruen (2012) refers to as the obfuscation of ostensibly “open” information.

To understand environmental issues, the nature and context of the site are important, so I opened the title “Environmental Group Site - Site Plan”. This revealed additional guidance information and a link to an attached Mine Site Plan supplied as a downloadable pdf file (Figure 7-5). The Site Plan was overlain on background imagery showing the nature, extent and scale of the operation, as well as the local environment. Key features were labelled and outlined by lines and polygons that were explained in a legend, aiding understanding of the operation, locality and immediate surrounds. The currency of the background imagery was dated as 2009, nearly four years old. This was surprising as the Site Plan was dated 2012. On the basis of the supplied information I was able to assess aspects of environmental compliance.

The area appeared to be well banded to manage water flows across the site. A sediment trap was in place in the south west corner and the top soil and over burden had been retained,

³⁷ <http://alisterclark.blogspot.com.au/2013/05/will-australians-use-our-ears-western.html>

presumably for rehabilitation. An understanding of environmental management is necessary to make these assessments thus limiting the ability of the general public to contribute. If the Company or the WA government explained the benefits of such practices, it would help in demonstrating how they are ensuring environmental compliance.

Figure 7-5: Site Plan for Boral Transport's Seven Mile Hill Mine near Kalgoorlie, WA



Other concerns can be identified based on the supplied information and general knowledge. Firstly, the disturbed area is nearly twice that approved: 23.0 hectares actual, compared to 12.7 hectares approved. This exceedance appears due to areas used for stockpiles and if not justified could constitute grounds for a legal challenge regarding non-compliance. Given this exceedance it is also questionable if the bond amount of \$54,000 is appropriate for the larger disturbed area. Otherwise, the government, lease holder and general public should be concerned that the area will be adequately rehabilitated on mine closure. The large amount of stockpiled materials may implicate the market for materials, and hence the operations profitability. The company and other stakeholders such as investors should be concerned about possible profitability issues arising from a legal challenge or poor material sales. Lastly, there are potential water quality issues with the extension of the disturbed area alongside the water

course adjacent to the northern boundary. No sediment traps are in place. Public dissatisfaction with these environmental concerns could lead to challenges to the mines continued “social license to operate”.

After assessing the supplied information, I was then interested to see where the mine was located, to understand any wider contextual issues. There was no information on the supplied Mine Site Plan to provide orientation: any north reference, grid reference, other geo-referencing, listing of a locality or prominent known features. However, under the heading Site Summary there was this description of the location:

The Seven Mile quarry is a hard rock quarry located 8.0 km directly south west from Kalgoorlie townsite approximately 1.5 km south of Great Eastern Highway.

The location “Seven Mile Hill, Kalgoorlie” was not recognised by Google Maps, but was found using the distances from Kalgoorlie off the Great Eastern Highway.

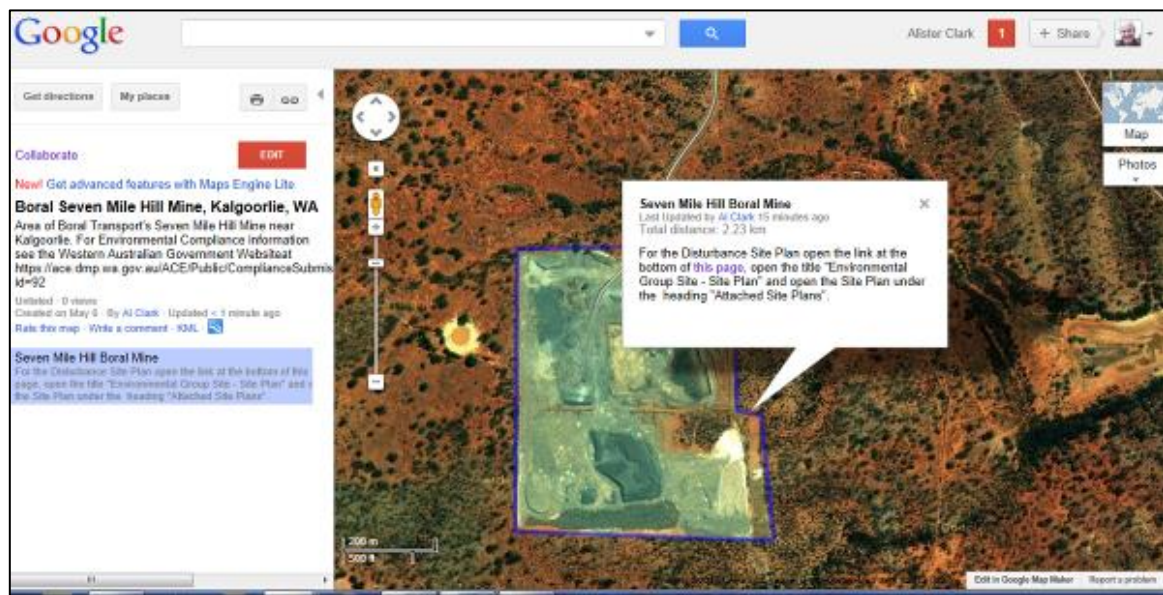
A closer view shows the area clearly matches the pdf site plan, despite the differences in surface stockpiles. These differences in the stockpiles are interesting as the Google imagery is dated around 2009 / 2010, close to that of the imagery in the pdf Site Plan. Temporal views provide an important aid to analysis. In Google Earth an image version of the pdf was draped over the background satellite imagery. The pdf had to be converted to an image file first but the fit was not perfect and there was limited ability to zoom in as the overlay quality quickly diminished. It did however firmly place the Site Plan in its wider context.

Next I sought to use GeoWeb 2.0 to make this information and my assessments more widely accessible and reduce the need for others to repeat the above process. It could then be distributed further through Social media, other contributions annotated, or be remixed and re-used. This might not, however, be legal. While the information allowed public access, the WA Government retained copyright on all website information, a very clear and limiting constraint on further use of the “open” information. However, in the interest of research and the public interest, I explored how an online GIS could be used.

The KMZ and KML files created with Google Earth were not easily uploaded to Google MyMaps or MapMaker and, with the concerns about copyright, this approach was abandoned. Copyright issues were avoided by not copying the pdf image, just making clear where it belonged. For this the pdf location on the WA website was linked to a simple location in a

Google MyMap³⁸ (Figure 7-6). The linking approach was also tested on the location for the Carnilya Hill Mine. A point showing the general location of the Site Plan was provided and linked back to the EARS. This demonstrates a simple method of providing an online map that shows clearly where each mine is located, with links across to the EARS information and Site Plans.

Figure 7-6: Google MyMap with the Seven Mile Hill Mine location outlined, showing pop-up text box with link to the EARS site listing.



Using a platform such as Google MyMaps can allow anyone to annotate the map, without compromising the source information. The public could provide direct comments related to the location of issues on the map. I added some of my comments to the MyMap as an example. Those living near or visiting the site could add valuable on-ground “audit” observations and photos, augmenting current avenues for providing feedback and potentially more open and transparent. Any comments made are public and cannot be mediated or removed, reducing the capacity and temptation for unfavourable comments to be quashed. Comments may be wrong, objectionable or irrelevant, but the Government or the Company has equal ability to respond.

Google is not the only online interactive mapping platform that can be used in this way. Bing, Yahoo and MapQuest all provide MyMap capabilities, and there is a burgeoning range of more specialist online mapping platforms, such as ArcGIS online, CrowdMap, and Geocommons.

³⁸ <https://maps.google.com.au/maps/ms?msid=217568692591192122146.0004dc16ec80f5f6d42fc&msa=0&ll=-30.845684,121.380687&spn=0.010188,0.01929&iwloc=0004dc17b6e3a56316116>

As well as allowing people to annotate the Map, many of these platforms also provide mechanisms for sharing and distributing the information via other Social media and networking platforms. With these mechanisms public exposure and accessibility can be increased. With a little more work and expertise, many of these platforms can be “mashed-up” with other spatial information. For example, biodiversity records from platforms such as the Atlas of Living Australia could be integrated with the Site Plan to show the location of nearby significant flora and fauna, further increasing transparency of the environmental issues relevant to the context. Initiatives such as GovHack, discussed in Section 7.6, can focus attention and expertise on these possibilities, driving their evolution.

The EARS initiative is a step forward in transparency for the mining industry and Western Australia government. Such compliance reporting need not only be done for mining; it could be done for any activity with potential for environmental impacts. This initiative will hopefully spur other sectors to follow creating a race to the top in transparency (Gruen 2012). My exploration highlighted ways this information can be used and value added by anyone with the inclination, time, access and literacy. Whether the information provided had been easy to access and understand, and hence open to a broad public, depends upon the computer literacy and knowledge of spatial information of each individual. The benefits extend beyond environmental sustainability to wider societal sustainability activities. In this example Boral is a public company, and shareholders may be able to use the information provided to assess the operations profitability and exposure to risk. At the time I thought if scaled up such transparency could assist larger efforts such as the Asset Owners Disclosure project (AODP 2013), a project concerned about the exposure of superannuation assets to future risks, including environmental. While reviewing this in 2015 I revisited the AODP and the website had incorporated an interactive map.

After writing up the story of my exploration, I considered how to provide feedback. On the original entry page to EARS there were clear instructions and a medium for providing feedback. However, when I followed the link I was taken to a page stating feedback can be provided either in person, via telephone or via a feedback form. I do not live in WA, so in person was out of the question. The telephone option was too difficult to explain some of the spatial issues, and I had taken the time to write this up as clearly as possible. I then investigated the feedback form, but this consisted of predefined boxes to fill in that did not relate to what I

had written. It was set up to collect the information the WA government wanted, not the information I wanted to provide. To use this would have required considerable extra work.

The EARS web page listed the General Manager's email address, to which I sent my original document on 16 May 2013. To do so the images in the original document were compressed which reduced their quality. I received an automated "out-of-office" reply to that email. Expecting that a General Manager's emails would have been important enough to be taken care of by someone else I waited but received no further email. On 21 May 2013 I incorporated my analysis into a blog and followed up with another email to the General Manager on the 8 August 2013, this time including a link to the blog, but no reply was ever received. The link to the blog was shared via Google+ and to date the blog has no comments or +1's.

The experience with EARS highlighted how it is possible for an individual to use FGW2S without programming to analyse open information and publish, thereby contributing to the environmental auditing and compliance. While this was possible it was not necessarily easy to access and use the "open" information, showing how not all open information is equal. While it was possible to publish what I did it was also possible to be ignored. That the government department had published its initiative implied an interest in any public experience that did not translate into action. Getting attention does not follow automatically from being able to publish, and making information open does not mean there is a commitment to supporting further outcomes. Part of this may be attributable to information overload as more people publish, what Spivack (2012), likened to a room full of people all speaking louder and louder in an effort to be heard.

The responsiveness of government and commercial organisations was commented on in a discussions of possible quality and response issues with increasing commercial production and control of information (Leszczynski 2011; McDougall 2010) Concerns were regarding the quality of commercially provided data that often contains crowdsourced and volunteered geographic information and is not subject to the same level of quality assurance as government data. While the commercial data can be initially of lower quality, this can be quickly fixed when pointed out as I encountered with Google in Stage 1, while government providers can be less responsive as shown by my experience with EARS.

7.6 GovHack 2013

GovHack (2014) is a national event aimed at demonstrating the significance of open (government) data and mainly open source ICT technology. It is part of the movement towards more open government information, epitomised in Australia by Gov 2.0 (AGIMO 2012). The GovHack 2013 competition was staged over the weekend 1-2 July and open to anyone to compete in adding value to open government data. It was run by volunteers and a not-for-profit organisation but with the support of government and industry. The incentives to participate include ideology, notoriety and prizes donated by government and corporate sponsors. Within the allowed 48 hours participants generate an idea for using open data, build a demonstration, and communicate what they have done with a three minute video. The results are then made public.

I decided to participate in GovHack 2013 to investigate ways to overcome technical difficulties discovered in Stage 1 and to explore different manifestations of ideas of openness. I turned up on the Friday night start as an individual, and teamed up with four others who had also come along “just on spec”. Our team, The Tassie Tigers, was awarded two prizes. The demonstrations were mashed together in a very short timeframe and everything did not work perfectly, but provided a general idea of what was possible. Many of the GovHack 2013 entries employed spatial representations using free and open source software (FOSS).

After the event I summarised the significance of GovHack, sent the summary to several organisations and also published the summary on my blog.³⁹ While tailored to each organisation the documents generically summarised the event and its significance as:

- better access to information to support organisational objectives
- increased outside scrutiny of organisational activities
- challenges to traditional forms of authority and control and
- substantial challenges to organisational structures and the roles of employees.

Making government data accessible is the first step in making it open and progress is well underway. The problem often remains in discovering, synthesizing, analysing and communicating this information. GovHack provides tangible demonstrations of what information is available, together with the application of sophisticated information tools that

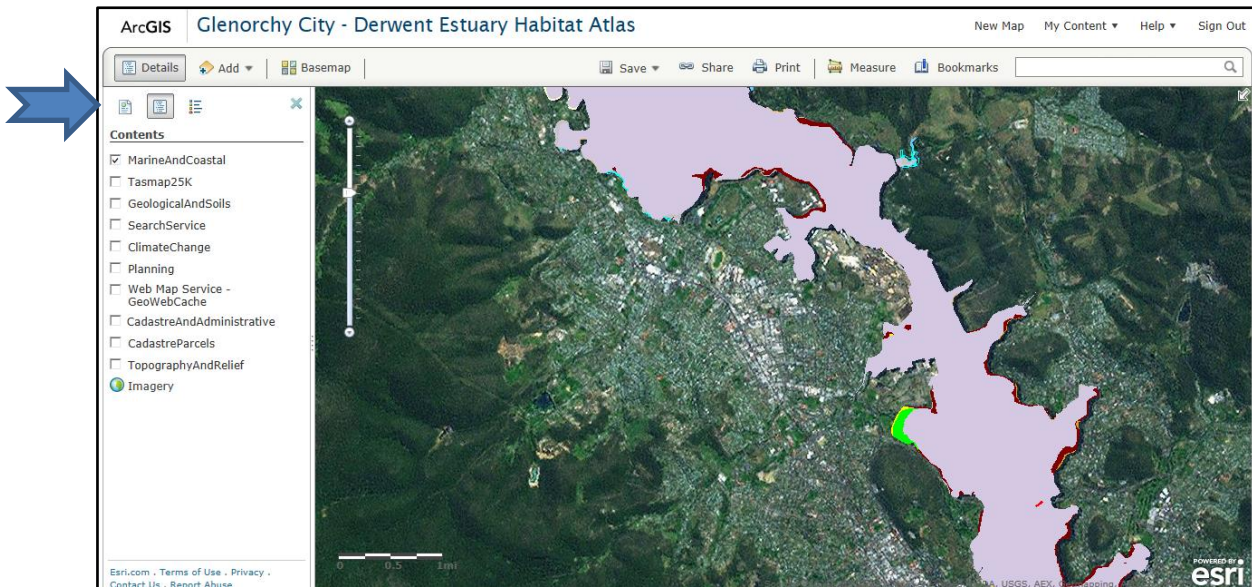
³⁹ <http://alisterclark.blogspot.com.au/2013/06/govhack-2013-and-open-government.html>

make it easier to understand. The entry “Solar Energy in Australia” was an excellent example portraying the uptake of solar energy across Australia. Making this information available outside of organisations increases the possibilities for public scrutiny. Raw data are made accessible to a wide audience through integration, synthesis and presentation. Responding by not releasing information entails its own risks, as the ability to expose this is also increased, as shown by the entry “The Open Index” that portrayed the openness of government departments.

Opening up this information challenges established positions. Helping people to navigate this new information landscape, discover, filter and assess resources, will be essential. Organisational boundaries will become more porous and traditional structures will need to be reassessed and adjusted as they are bypassed and become redundant. Corporate governance can be completely transformed. It is possible that many current roles will become redundant, but just as likely that these will be replaced by new roles that may not exist or have even been thought of now. The developments enabling GovHack type practice are driven by forces that are larger than individual organisations and even nations: globalisation, ICT technology and the internet. Without major societal disruption, they are likely to continue and appear to be gathering pace. Awareness and preparedness are probably a better response than denial or resistance.

During GovHack2013 I investigated and demonstrated how to create a public online portal to view most of the state government spatial information held for Tasmania, to help our team understand the data available. This was by using the cloud based GIS, ArcGIS.com, and connecting to the State Governments GIS web service (Figure 7-7). Despite the title it connected to most of the Tasmanian Governments web services GIS layers (theLIST). All the layers can be accessed by clicking on the “Show contents of map button” on the top left indicated by the blue arrow. The ArcGIS.com option was, however, not allowable under the rules of GovHack as entries had to use FOSS. While ArcGIS.com is not open source, it was a free and easy way for a non-programmer to visualise, modify and publish maps online using web services connected to live data.

Figure 7-7: ArcGIS.com view of Tasmanian spatial data provided through web services



Source: (Clark 2013)

When I first set up a GIS in 2006, the financial resources required included a software license of \$1000-2000 annually and purchase of data at around \$7000-10000, static data that was soon out of date. This was only for an individual application viewable on one desktop computer. Providing it for others would have entailed much more expense. The work done with ArcGIS online to integrate data from web servers is also an example of how a mashup can be created without programming expertise. It is not possible to ascertain whether this is an example of (later) discovery, or the technology changing to make it easier.

GovHack is an example of how community use of GeoWeb 2.0 and open information can be fostered from the bottom up. It is an innovative process in which expertise within the community can be brought together, with potential for computer experts to collaborate with people with less technical expertise. Use of open source GeoWeb 2.0 applications was prominent. GovHack was, however, structured to be accessible mainly to the computer literate and open source enthusiasts. The restriction on only using open source software led to long debates with one GovHack proponent about what is “open”. I consider GovHack’s definition as partial and exclusive of those who did not program and use open source software.

It is unlikely that one initiative alone can include all requirements, and other programs such as the NBN and Landcare Social media workshops provide alternative bottom up support

approaches. I participated in several workshops and webinars throughout 2013 that focussed on assisting community members to use Social media. The workshops were part of the National Broadband Network implementation and Digital Futures program, and focussed on assisting not-for-profit organisations use Social media. I also had four private meetings with the organiser (CT) in which we talked more specifically about my research. A webinar by Landcare Australia focussed on assisting Landcare group member's use Social media. During these interactions, I asked questions regarding the use of maps. Both the Social media workshops and webinar did not include interactive mapping platforms as Social media. CT's perspective was that use was too difficult for the perceived benefit and was only relevant to enterprises using location based services. The Landcare webinar presenter reiterated the perspective that not much was known about online interactive maps and their use.

7.7 Summary: bottom up potential

This chapter presented the results of engagements with existing bottom-up initiatives, and described my own experience in using GeoWeb 2.0 from the bottom up. Engagements with several community groups demonstrated how FGW2S provide opportunities for groups and individuals to create and share broad environmental information and value add to information provided by others. Motivation appeared to be the most important factor for participation, followed by awareness of the possibilities and the technical ability to use these. There is then an increasing potential for broad participation in information creation, sharing and curation. Institutions are interested in the possibilities, but BOM and SOE reporting experiences indicate they are also influenced by awareness and resourcing.

For organisations aggregating information across large scales from diverse, heterogeneous sources, a barrier to crowdsourcing and VGI is the semantic mediation of that information. Concerns about syntactical and semantic information mediation are reflected in the approach and design of other existing online citizen science or crowdsourcing initiatives, such as Climatewatch, RedMap, FeralScan, MySwan, and the Atlas of Living Australia. These initiatives have all been designed and controlled by large government or research institutions and they determine what is important and how people will interact. Information that can be volunteered is limited to their interest area. Controlling the form of information submitted is reportedly done to minimise uncertainty and problems of semantic mediation. The information is pre-organised. Doing so disempowers the people contributing, allowing them to only express

what the platform providers want to know and how. In terms of Haklay's (2013a) typology of citizen cyberscience, Australian applications are mostly of level 1, Crowdsourcing and 2, Distributed Intelligence; they do not exhibit many characteristics of level 3, Participatory Science or level 4 Extreme, Collaborative Citizen Science. Where multiple platforms need to be used to encompass any individual's knowledge, their knowledge is then fragmented. This excludes many possible contributors and does not access the full creative power of those that do; human sensors who can understand abstract concepts of purpose and meaning.

Through the EARS experience I demonstrated how an individual could use GeoWeb 2.0 and open information to contribute to environmental sustainability. This experience also revealed that while organisations may provide open information this may not translate into more responsiveness to the outcomes. This has a feedback effect on the motivation of others to contribute, dampening the possibilities. The attitudes of organisational personnel are important, especially those in senior leadership positions who have greater influence on overall organisational culture.

Initiatives such as GovHack and Social media workshops are government sponsored initiatives that did not seek to create GeoWeb 2.0 resources, but provided support for bottom-up uses. Their focus was to develop community capacity to use existing (non-institutional) Social media for their own purpose. This support is both technical and social in the form of contacts and support, and should contribute to raising awareness of potentials, ability and the motivation to participate. No one initiative is inclusive of all requirements, but this could be achieved with a diversity targeted across a broad range. In contrast to GovHack, the Social media workshop experiences added evidence that the Geo component of Web 2.0 is not well recognised, understood or used in the wider community. The Defence Review of Social media (George Patterson Y.R. 2011) also did not include GeoWeb 2.0 developments, adding to the perspective that understanding of its significance was nascent in the wider Australian community.

In the next chapter I describe and discuss my engagements with top-down initiatives.

Chapter 8 Stage 2: Top-down initiatives (2012/13)

This chapter focusses on engagements with two top-down initiatives. The first was with SenseT, an initiative to develop sensor networks across Tasmania that commenced in 2011. Its description is separated by the second engagement that occurred in late 2012 to early 2013, a review of the Co-operative Research Centre for Spatial Information (CRCSI) research agenda, the provision of feedback and subsequent discussions with the report author. Also included are interactions with two State government authorities responsible for feral animal management that resulted from sharing data on FeralScan, and perspectives from workshops and other minor interactions.

8.1 SenseT: Tasmania's Sensor Network

SenseT (2013a)⁴⁰ was identified as a Tasmanian ICT project of relevance both as a source of research data and for what my research might provide through Action Research. An unfolding research project, the SenseT initiative is developing a sensor network and knowledge management system for the State of Tasmania, with the following vision:

Tasmania has a sustainable ubiquitous sensor network and knowledge management system supporting sustainable economic, infrastructure and social investment (SenseT 2011b).

The overall goal for SenseT was also stated as:

To establish a world-leading sensor and knowledge management network to drive economic, social and environmental benefits for Tasmania (SenseT 2011a).

Discussions in other SenseT documents (UTAS 2012a, 2012b) include sustainable land use, planning, integrated energy and catchment management.

The degree to which SenseT incorporated GeoWeb 2.0, and reasons for the degree of incorporation, were thought to constitute important data informing my research. Conversely, observations from this research regarding GeoWeb 2.0 might inform the development of SenseT. The emphasis for my interactions with SenseT were framed by perspectives expressed in Chapters 2 and 6. These were firstly the perspective of environmental sustainability as a value-laden concept, strongly context dependant and requiring broad community inclusion and

⁴⁰ <http://www.sense-t.org.au/>

participation. A sensor network designed for environmental sustainability should include humans as sensors.

The information requirements for environmental sustainability extend beyond an objective scientific representation of the physical world that can be collected by machine sensors, to include possible alternative representations, values, beliefs and actions. Information about alternative views, values, beliefs and actions can only be supplied by humans, including both non-experts and scientists. For example, the Urban Emotions project (Heidelberg University 2016) is developing a methodology to extract contextual emotional information from crowdsourcing platforms for integration into spatial planning. SenseT as a sensor network includes machine sensors, but needs to include humans as sensors to incorporate the full range of relevant information, knowledge and wisdom including abstract concepts. It may describe a “state of the environment”, but cannot allow alternative representations, such as representation of the “state of our environment”, or capture value decisions about whether such a state is good or bad.

Further, the internet arguably constitutes the most critical emerging societal-wide knowledge management system, with Web 2.0 the manifestation of the internet that has potential to support an inclusive, participatory and collaborative vision of environmental sustainability. GeoWeb 2.0 provides the potential to add location and contextual nuance to support collaborative visions of environmental sustainability.

Using the Action Research methodology, I aimed to be a part of the development process, to both observe and input aspects of my understanding of GeoWeb 2.0. Observing how elements of GeoWeb 2.0 were being implemented in SenseT and if any of my contributions were acknowledged or countered, formed part of the research data. Through engaging with the project I sought to understand the opportunities and barriers involved. I was interested in indicators of how SenseT might be open or participatory, and the degree to which it incorporated spatial capabilities and information. SenseT documents, web pages and media releases were reviewed to understand how the project was conceived and promoted. Comments were provided on several briefs. I collaborated on a proposal for a potential SenseT project and PhD scholarship, attended a monitoring and evaluation workshop, and conducted discussions with a key SenseT employee.

The first engagement with SenseT was in September 2011 and consisted of comments on early project briefs regarding assumptions about sustainability, particularly that more data equals better decisions, and an emphasis on data on physical conditions and less so on the social context and values. Of the extant media, the most important and perhaps revealing was the SenseT brochure (SenseT 2012b) that contained imagery predominantly of technology, ICT and infrastructure, and production landscapes (Figure 8-1, Figure 8-2). The few people included do so in working contexts: hurrying to work, producing cheese, in machines growing and transporting produce. People enjoying non-technological or productive environments, contexts that are otherwise important and enriching to people and society, are absent; they are mostly backgrounded behind the technology: a hand holding a telephone or anonymous people in a crowd viewed from behind or obscured in vehicles.

Figure 8-1: Front cover of initial SenseT brochure, June 2012.



(Source: SenseT 2012b)

This imagery can be interpreted as depicting the value orientation of those in authority, or at least their intentions about how they want the project positioned and perceived. The significance of these early images is highlighted by comparison to images in subsequent media (Figure 8-6, Figure 8-7). This early data depicts SenseT's initial focus as predominantly on

science, technology, and commercial applications that provide quantifiable economic outcomes. Counts of word frequencies in early media also show an emphasis on “information” and words regarding physical properties rather than social or human. The words Web 2.0, participation, openness, and interaction are missing early on.

Figure 8-2: Second page of SenseT brochure, June 2012.



(Source: SenseT 2012b)

SenseT was also initially conceived as a one-way flow of data, information and knowledge from experts to users. Relevant information was represented as objective data collected by machines created by experts, backgrounding the values and choices already embedded in sensor construction, selection and deployment. Sensors to collect data were conceived of as machines and the role of people as sensors was largely not broached. The machine collected data was to be processed into information and knowledge by machines and experts, and then presented to the (business) community for usage. Most of the discussion around the community regarded how they access data and information rather than provision, except through a citizen science project.⁴¹ I interpret this as an expert (science / government) informed top down approach to “planning and pushing” technology into society. In this respect the project did not

⁴¹ I had contributed a citizen science project that was positioned as part of the monitoring and evaluation

initially seek to incorporate any of the technological, process or cultural developments associated with Web 2.0 that allow broader interactivity and participation. As a result of this early engagement I attended a SenseT monitoring and evaluation workshop in October 2012.

The SenseT monitoring and evaluation (M&E) workshop was conducted over 9-10 October 2013 at the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Marine and Atmospheric Research Lab, Castray Esplanade, Hobart, Tasmania. After the workshop I wrote up my perceptions of the conduct of SenseT to date, with specific reference to the M&E workshop as articulating its most recent manifestation. As such, those perceptions formed part of the feedback and reflexivity involved in Action Research.

The M&E workshop explained SenseT's initial focus as required by its initial funders, supporters and potential users. The initial funding was part a regional forest agreement aimed at providing economic alternatives for those communities most affected by the loss of forest industries. The first projects were "proof of concept" projects demonstrating the value of improved data / information for local economic, social (employment), and environmental outcomes. Social and environmental outcomes, although acknowledged, were given less emphasis and were seen as achieved as a result of the achievement of the science and technology supported economic outcomes. Less consideration had so far appeared in the available documentation of the possibility that the technology might not be beneficial, and that science and technology might not deliver favourable outcomes. While the same SenseT brochure was available at the registration desk, the M&E workshop provided evidence of a shift in emphasis in which social factors and participatory design became more prominent in the discussions.

The workshop included SenseT proponents, ICT and primary industry experts and managers, University of Tasmania researchers, computer scientists, economists, agricultural scientists, geographers, social scientists, and a philosopher. Government department, community and industry representatives also attended. The facilitator of the workshop demonstrated an ability to balance and provide space for diverse views around science and social science, quantitative and qualitative methods, top down and bottom up, controlled and open approaches. Participants expressed their approval for this wider inclusion and the desire to see it continued and broadened. The proponents expressed their desire to do so and cited resources as the major constraint.

There was much talk about participatory design, an Action Research approach and other wider social science research and qualitative methods. Proponents used stakeholder workshops already conducted in the initial projects as evidence of implementation of a participatory approach. The role of monitoring and evaluation in participatory design was seen as crucial and hence needed to be incorporated from the beginning. I saw this stated intent as conforming directly with the function of “openness” as being integral, as well as contributing, to the development of GeoWeb 2.0. I asked to what extent humans were to be considered as sensors: was it part of the scope of SenseT to allow contributions of information from people, as well as physical sensors. The reply, “that it was definitely possible to allow information to be annotated”, indicated this meant allowing contributions to be annotated to existing information but did not include the ability to submit entirely new independent information. This demonstrated a tendency for SenseT proponents to align community input with monitoring and evaluation which is only a subset of possible information to be derived from using humans as sensors.

Wider comments occurred regarding crowdsourcing and its applications, with the predominant concern being the quality of such information. These were included with discussions on provenance which, however, appeared to be used as both a means to support decisions on the quality of the data (such as who collected it, where from, and how), a form of metadata; to informing questions on the quality of the object or service the data was describing (the provenance of oysters, where bred, the water quality, the sustainability of the practices). Referring again to Haklay’s (2013a) typology of citizen cyberscience, SenseT mainly positioned contributions from citizens other than professional scientists at the first level of crowdsourcing, limiting the ability to harness wider intelligence or engage citizens collaboratively.

The SenseT Director asserted that the overall approach was one of Action Research. I noted that if SenseT aimed to be participatory then the overall approach should be closer to Participatory Action Research. Both methodologies seek to create change as well as creating knowledge, by putting knowledge into practice through the research process. The difference is primarily in the relative difference in power relationships between the research proponents and the participants, with PAR seeking to even out that difference. For that purpose, an ongoing stance and practice of reflexivity is essential for the proponent to understand how they are being presented and perceived, and hence if this power equalisation is being achieved. Regarding

power relationships, the program did not appear to consider the effect of conducting the workshop at the Commonwealth Scientific and Industrial Research Organisation's premises, which can be perceived as emphasising the scientific perspectives of this organisation. Project proponents and related experts attended in dress that emphasised power, for example suits, and the stating of a person's role and organisation also emphasised their relative status.

At the workshop, government, community, science/technology and research representatives were all given equal time and opportunity to speak on a selected panel. Conversely, however, there were dominant speakers in the workshop, confidently interjecting while those who waited and used hand signals to indicate a desire to speak often missed out. Reflexivity would help the program to consider the settings and conduct of the main modes of instigating Action Research and PAR, such as the M&E workshops. I observed that the integrity of the M&E program in accurately reflecting the societal requirement for and impact of SenseT is closely dependant on the independence and strength of the governance framework. This could be formalised into the M&E framework with one measure of success being the identification of situations in which SenseT is not appropriate.

The workshop demonstrated that within SenseT spatial data and enablement are considered essential. There were representatives of key stakeholder groups that collect, manage and distribute considerable spatial data including the State Government's Information and Land Services Division (now Land Tasmania) that operates the Tasmanian Land Information System (theLIST), the Australian Bureau of Statistics and the Bureau of Meteorology. Some of the spatial information held by these organisations would be available to SenseT to be integrated with its sensor data. It was not quite clear how that spatial data would be delivered or made available, presumably through a discovery service and online viewing platform or geobrowser. The intent was to find and integrate as many spatial data sources as possible. This can be interpreted as supporting wider "openness", if such data are then made available for further use. How much and to what degree data should be open for use was still a source of debate within SenseT, with priority issues being privacy, security, equity of access and intellectual property.

The initial SenseT concept did not explicitly include incorporation of GeoWeb 2.0 capabilities to facilitate broad community sharing of environmental information. Nor did the project proponents consider that this should be an important consideration. This was due to the ontological view point of the initial proponents, partly determined by politics and

demonstrating the importance of the world-view of ICT system architects in determining what the technology will allow. The conduct of the M&E workshop demonstrated a move towards greater openness, that may support the inclusion of GeoWeb 2.0 capabilities into SenseT, and conversely also that may be supported by the incorporation of GeoWeb 2.0 capabilities. However, there remained tension between the practicalities and short term objectives necessitated by political and funding drivers, and the longer-term objectives for the broader overall goals of supporting Tasmania's economic, social and environmental sustainability. Others I spoke to at the workshop also noted that the expressed intentions promised a participatory and inclusive direction, but that it remained to be seen the extent to which this could be translated into practice in the face of political and or commercial pressures. It was evident that spatial capabilities will be incorporated into SenseT, but not that this would allow two-way interaction through the incorporation of GeoWeb 2.0 to facilitate the role of humans as sensors in providing (geographic) data and information.

8.2 Australian crowdsourcing research

In late 2012 the Co-operative Research Centre for Spatial Information (CRCSI) released a draft of its research strategy planned for commencement in 2013 (West 2012). Research Strategy P3, Sub Project 3.03 – Jurisdictional Level Data Integration, Topic 1: Use of crowdsourced data and its integration with authoritative data, related closely to this research and encapsulated the views of a large proportion of the Australian stakeholders in spatial information research. The document was reviewed, seeking to ascertain the intent of the research direction and included my perspectives based on research conducted to date. The review was sent to the document author, who responded with comments, to which I replied. The following summarises most of that review and related comments, and my later perspectives. The scope of my review was on three related documents (Australia 2012a; McMeekin 2012; West 2012) found on the CRC –SI website (CRCSI 2012).⁴² Of interest was the CRCSI perspective on crowdsourcing:

Use of crowdsourced data and its integration with authoritative data: It is becoming more desirable for a number of reasons (speed, data currency, cost, commercial gain) to consider crowdsourced spatial data, either voluntary (VGI) or involuntary. Crowdsourced data from Twitter feeds has been shown to be useful in emergency situations (20-30 minutes quicker than more traditional intelligence (Mark Wallace, pers. comm., 2012). It can also be used to correct or augment authoritative

⁴² Note that this website has changed substantially since 2012

data. Of course VGI needs good quality control (Goodchild, 2007). An example of the use of relatively simple ontologies and Semantic Web technologies operates at present to identify and resolve errors between Open Street Map and the UK's Ordnance Survey road data (Du et al 2011). Diaz et al (2012) propose a technique for searching for VGI data, including real time data, using OGC's Open Search Geospatial and Time specification. Examples include Twitter, Flickr and Wikipedia. An example is described for queries concerning forest fire monitoring. Flickr produced geo-located pictures of the fire. Another recent development is the OGC's Open GeoSMS that allows the encoding of location content in a short message (the GeoSMS app available for the iPhone) and allows the location to be shown on Google Maps. Overall there are a number of avenues to explore the use of the Semantic Web, W3C and OGC standards to make more use of crowdsourced data (West 2012, p.9).

McMeekin made special emphasis of the crowdsourcing sub-project in his presentation, repeating the observation above regarding the currency of Twitter feeds in emergencies. Several of the diagrams used by West are also used in the presentation.

The use of the term "crowdsourced" was interesting, given the discussion in the spatial literature is around terms such as Volunteered (and increasingly Contributed) Geographic Information (Coleman 2010; Coleman, Georgiadou & Labonte 2009; Elwood 2008b; Flanagan & Metzger 2008; Goodchild 2007a) (noting West's use p.2, last para.), Neogeography (Goodchild 2009; Haklay, Singleton & Parker 2008; Turner 2006), Neocartography (Cartwright 2012; Crampton 2008; Liu & Palen 2010), and Mapping Mashups (Batty et al. 2010; Cartwright 2011; Miller 2006). This may reflect West's conversations with Goodchild (p10), who uses the term in the title of a recent book of which he was an editor (Sui, Elwood & Goodchild 2012). This book was not cited in the reference list, and only one other reference, that by Goodchild (2007b), is common to the literature I have reviewed.

West (2013) stated the concern was the utility of crowdsourced information for state based organisations such as land information agencies and for disaster management. The Western Australian spatial agency, Landgate, wanted to integrate various user supplied data with authoritative data, for example corrections for points of interest databases and speed limit signs. The Queensland government agency wanted to integrate Social media such as Twitter feeds with other data for emergency and disaster management. The use of the term crowdsourced is appropriate in this context as one that is widely understood while the others are more specific and restricted in usage.

8.2.1 Key people, stakeholders and authorities

Those consulted by the CRCSI during consultation added to the range of relevant Australian academics and other stakeholders and showed how GeoWeb 2.0 was approached from different disciplinary perspectives or conceptualisations often with correspondingly diverse terminology. Kevin McDougall from the University of Southern Queensland was using the term VGI. I had not found any published work by Mark Wallace (Queensland Government), Femke Reitsma (Canterbury University, Christchurch, NZ) or Lesley Arnold (Landgate, WA Government). Landgate's interest in crowdsourcing was discovered through an interview on Radio Nationals Future Tense with Darren Mottolini (Funnell 2010b). I supplied the following list of the Australian academics whose work appeared relevant to the totality of GeoWeb 2.0 as a socio-technological phenomenon:

- Professor William Cartwright (RMIT) (Cartwright 2008, 2009a, 2009b, 2011, 2012)
- Kevin McDougall and associates (University of Southern Queensland) (McDougall 2009, 2010, 2011a, 2011b, 2012; Paudyal, McDougall & Apan 2012a, 2012b)
- Serene Ho and Abbas Rajabifard (University of Melbourne) (Ho & Rajabifard 2010). Rajabifard conceptualised other research mainly around a Spatially Enabled Society (GSDI 2012; Williamson, Rajabifard & Holland 2010), a more recent and wider concept for SDI with little reference to GeoWeb 2.0
- University of Melbourne work under the “Tell Us Where You Are” project (DIE 2012) and
- Marcus Foth and associates (Queensland University of Technology) conceptualise work under the term “Urban Informatics” (Foth et al. 2009; Foth, Choi & Satchell 2011a; Foth et al. 2011b; Foth, Schroeter & Anastasiu 2011c).

I did not include Australian PPGIS researchers such as Greg Brown and Deborah de Freitas with the above as their work did not appear to be addressing relevant topics. It is not until later that Brown and Kyetta (2014) explore the relationship of PPGIS to VGI; and the use of crowdsourcing through PPGIS for land use planning (Brown 2015).

The research focus of the CRCSI was mostly on ICT technology, although mention of OGC standards identified the importance of some social arrangements. This is while Sui, Elwood and Goodchild's (2012) book previously mentioned, considers the research domain as socio-technological in scope. I commented that the research leaders at the CRCSI all had expertise in computer science. West agreed the main CRCSI expertise was in computer science and software engineering, that the bias in the documents reflected the desires of the various CRCSI

participants to sort out technical issues stopping the generation of national datasets, and allowing small enterprises to exploit them. It also reflected the needs of the Federal government and land agencies in terms of the functionality they desired; the CRCSI has many participants that set the research agenda through a consultative process.

I commented that perhaps social aspects will be addressed through the initiative mentioned on the CRCSI web page under the list of what Program 3 will concentrate on, in dot point 4: “assisting with the design of next generation architecture using test beds that will be established in existing operational spatial infrastructures” (CRCSI 2012). Presumably the test beds would entail some mechanism for the crowd to volunteer or contribute information. West commented that this would be left to those researchers involved in the research into the use of crowdsourcing. The research agenda is driven by the stakeholders of the CRCSI and that the design of test beds would be up to those conducting the research.

The CRCSI’s view of crowdsourced information is its utility to “authoritative” data, a view that follows previous Australian authors such as McDougall (2009). Another position to take is that facilitating crowdsourced data and related practices such as Neogeography, is fundamental to a spatially enabled society because it helps people communicate with each other more effectively, collaborate and self-organise (Rajabifard & Coleman 2012; Warren 2011; Williamson, Rajabifard & Holland 2010). In the example of the emergencies used above, many of the Twitter feeds are people trying to communicate with each other. Providing a spatial view of these Twitter feeds would add value for more of the public, providing another view for the non (Twitter) literate. Spatial information, such as locations with no Twitter feeds, provoke questions of whether this should be investigated and informs who may be nearby to investigate.

The CRCSI positions “crowdsourced data” as different from “authoritative data” which could be interpreted as a judgement implying one is more valuable than the other. The people who volunteer or contribute information may not agree with this perspective. Spatial information is often produced for different purposes and the value is specific to the context, long recognised in the spatial sciences through the concept of fitness for purpose (Agumya & Hunter 1997; Devillers & Jeansoulin 2006a). Positioning the research in this way can create a power relationship that is imbalanced and affects perceptions by the wider public or crowd, whom presumably need to be engaged to contribute or volunteer information in the test beds.

West explained that the term authoritative is used because the land authorities, such as Landgate in Western Australia and the Victorian Department of Sustainability and Environment, own the data even though it may be contributed from other local authorities. These data are authoritative in that they must be accurate and defensible in a court of law such as in disputes regarding (property) boundaries. West maintained that it will always have higher credibility than volunteered data, and hence there is the need to reconcile these two forms of data. I suggested a title that might avoid this positioning could be “use of crowdsourced data and its integration with institutional data”. West agreed with this but with a qualification that the term authoritative was chosen by the CRCSI stakeholders. The definition of authoritative data as that which is accurate (enough) to be defensible in a court of law then relies on the law making some reference to a quality standard to which data can be compared and either found acceptable or wanting. This is a form of external quality (Vasseur et al. 2006) often defined in metadata standards and the result of substantial research predating GeoWeb 2.0. (Servigne, Lesage & Libourel 2006).

8.2.2 Whose credibility and who controls?

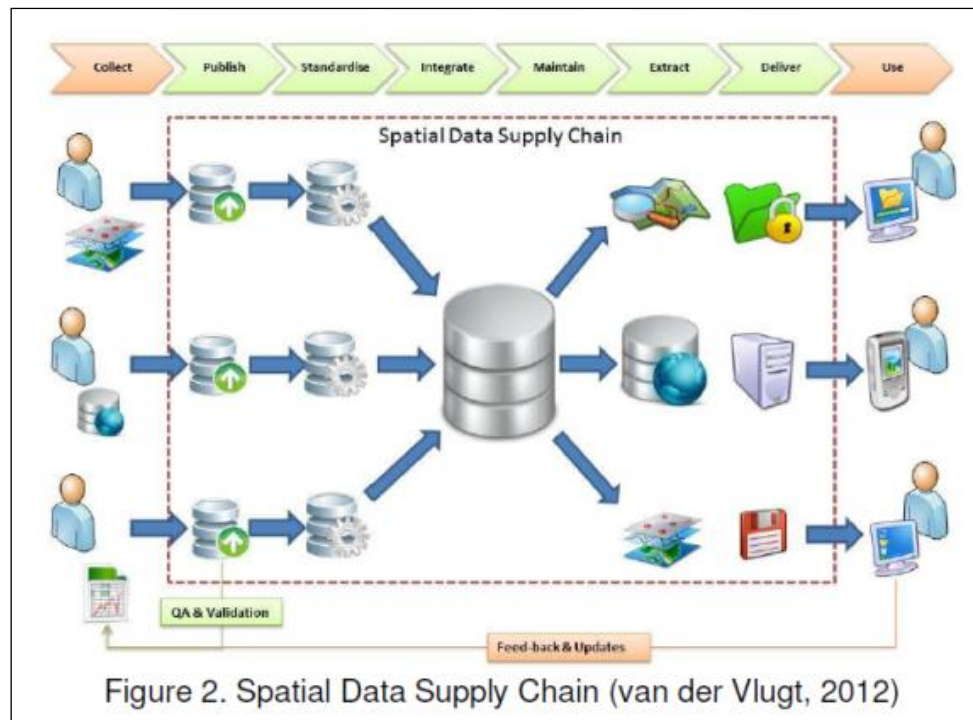
There are, however, issues where community standards are not necessarily explicated in law, but for which crowdsourced information can be thought of as more or less authoritative. Assessing authority and credibility is more problematical, institutions are not always impartial judges and acceptable as arbiters by the community (Flanagin & Metzger 2008). Some consideration needs to be given to situations where crowdsourced data informs issues of community standards not necessarily enshrined in law, or where interpretations of law may be at conflict. An example is that collected by applications like Ushahidi (Ushahidi inc. 2012) of crowdsourced data relating to acts of violence, electoral bullying and other intimidation by oppressive regimes. While this may not be thought of as relevant to western democracies such as Australia, the notion of whose information is authoritative is brought into focus by protest groups using GeoWeb 2.0 to crowdsource information relating to what they perceive as abuses of power by authoritative institutions. In Australia, activists were early adopters of GeoWeb 2.0, using it to support protest actions against forestry and “bad developments” (Cartwright 2009). Getup! has made effective use of GeoWeb 2.0 capabilities with its Coal Seam Gas map (Getup! 2012). Harwell (2000) revealed how focus on a particular authoritative type of GIS representation, remotely sensed imagery, ignored social realities contributing to the Indonesian forest fires.

Whether authoritative data will always have higher credibility than volunteered data assumes some knowledge of to whom the data are credible, with different communities (of users) having differing perspectives on what is more credible. The example of the protest groups highlights how they and perhaps many other community members will consider that information as authoritative and credible. Credibility is not the same as accuracy or quality and often relates to factors of reputation and trust (Bishr & Kuhn 2007; Gruen 2012). There is also the possibility that some volunteered data may actually be more accurate than “authoritative” data, especially where the latter is non-existent, which was found to be the case in recent Queensland floods (McDougall 2011b).

Hence, further exploration and explanation of the meaning of authoritative is required. Significant outcomes of GeoWeb 2.0 have challenged traditional authority and control by allowing more widespread, direct and diverse information production, publishing and network formation (Warf & Sui 2010). There are of course both positive and negative outcomes from this, but getting it right has been identified as supportive of a more participative democracy (OECD 2001). Building a spatially-enabled society which facilitates the crowdsourcing of geographic information has far greater significance beyond its integration with authoritative data (Warf & Sui 2010).

Understandings of how people use what information in a Web 2.0 context is important and revealing. The CRC SI Research strategy depicted a spatial data supply chain (Figure 8-3) where information from the producer’s progresses through several steps before being used. However, with Web 2.0 the connections between producer and user are often more direct, straight from publishing to use and the roles are interchangeable with producers being also consumers. McMeekin (2012) refers to this in his description of the difference between Web 1.0, where information is produced then consumed, and Web 2.0, where producers are consumers and vice versa (Figure 8-4). Building infrastructures based on the spatial data supply chain model shown in (Figure 8-3) may exclude people and practices, and the relevance or perhaps context of the diagram is not then clear. West commented that this reflected the controlling nature of the various land agencies that needed to control the data. The “controlling nature” and “need to control” of organisational culture is reiterated in the report from the workshop on creating a linked spatially-enabled Australian Information Infrastructure (Australia 2012a). This report recognised that change to organisational culture was a main impediment and “a culture of risk aversion (that) inhibits data sharing” (p2).

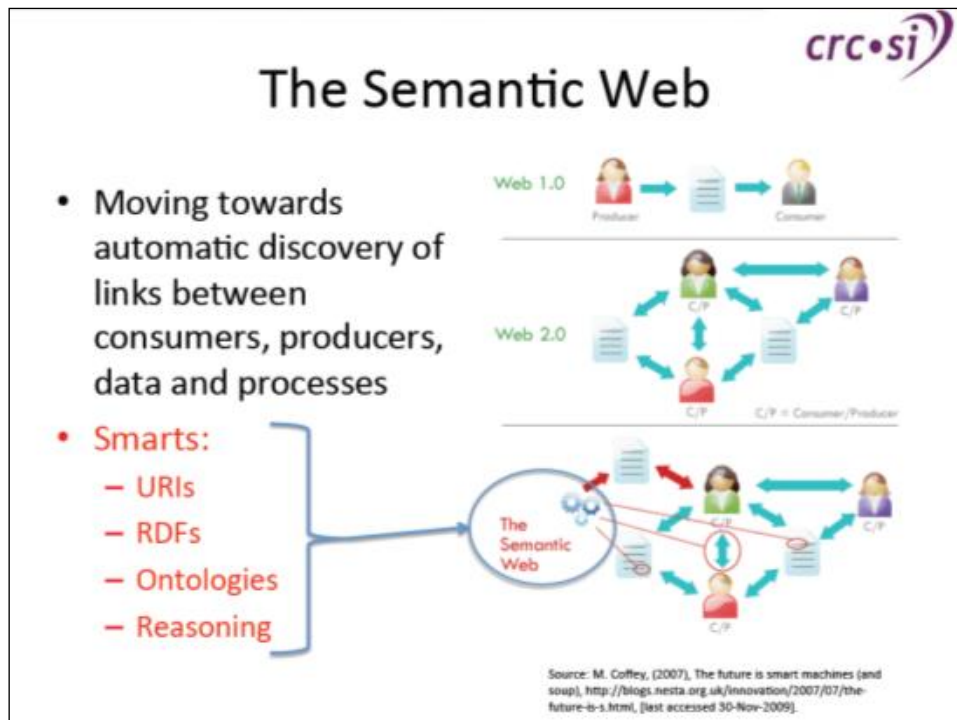
Figure 8-3: Spatial Data supply chain figure used in the CRCSI Research Strategy



(Source: West 2012, p.5)

A top down approach with the one point of control is vulnerable to failure and not an architecture of participation easily scalable to achieve network effects (Anderson 2012). Another issue is whether imposing these controls will affect the tendency for people to share (crowdsourced) information, if it becomes too cumbersome or time bound or is perceived as allowing the information to be mediated. Forcing all data through this process may then be counterproductive. There are of course some situations where a high level of control is desirable or essential, for example where the risk of low control is high, relative to the benefit. It may also be largely irrelevant for in many situations where data are crowdsourced, government agencies have no control, such as through Twitter. Some of this information could be harvested for integration into institutional SDI, during which quality control is undertaken post-volunteering.

Figure 8-4: Semantic Web diagram used in the CRCSI Research Strategy



(Source: West (2012) and McMeekin (2012))

Alternatively, relevant institutions may find it more effective to choose to participate in the open GeoWeb 2.0, taking on roles as curators and quality control agents on data that remains outside of the institutional SDI domain. The goal changes from control of information to creation and sharing to support civil society. The latter is perhaps more confronting as it means changing traditional roles and relinquishing some control. Government should have a governance role but perhaps that role needs to shift from controlling information to providing guidance on how it is created and used. Choosing when to do this is the difficult question, as there are certainly situations where Government should retain control, but is losing that control through the community's use of Web 2.0, GeoWeb 2.0 and Social media. For example, where third parties can unilaterally disclose online information about others, without prior approval. I find it a violation of my privacy that a foreign company, Google could publish images of my home to a global audience without any prior consultation or consent. It is also a constant source of concern that others can tag photos of minors online without any prior consent, either from the minor or their carers. I agree with Faulkner (2011) that people should have the right to decide what, when and where information about them is disclosed.

8.2.3 Semantic Web and SDI development in Australia

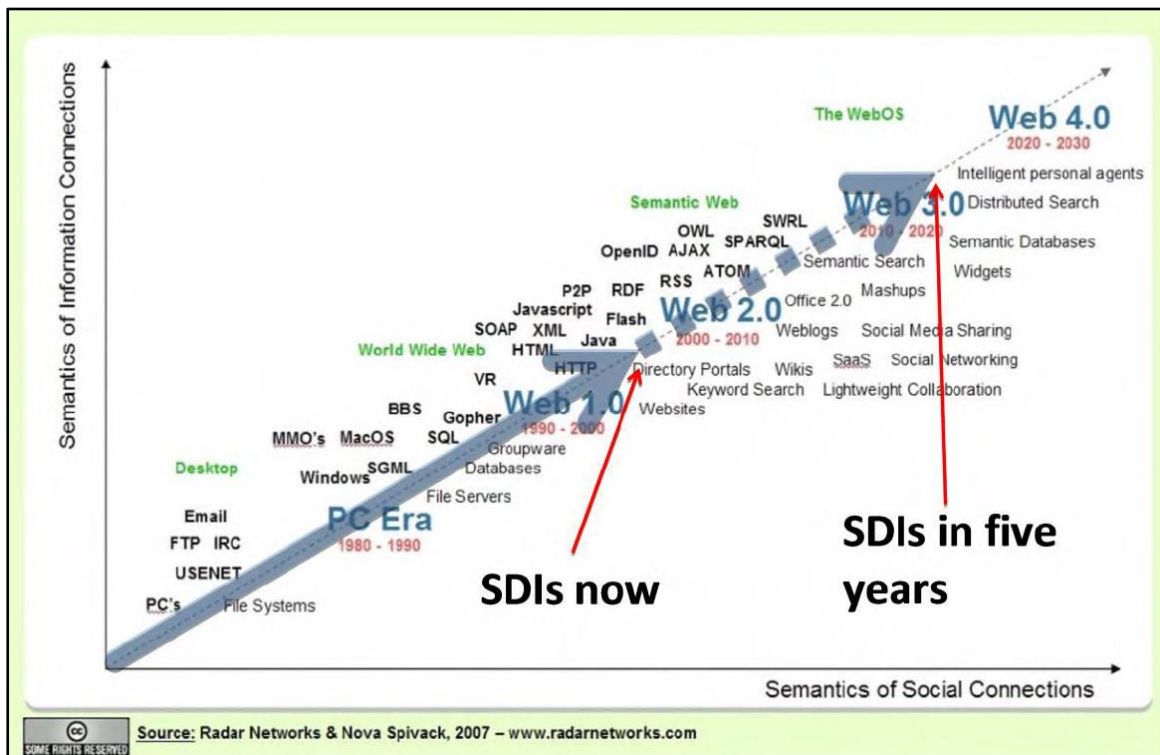
The depiction (Figure 8-4) of how the Semantic Web will automate creating links between consumers, producers, data and processes highlights the digital divide between those who are pursuing and understand the Semantic Web, and the majority who are yet to fully understand the implication of Web 2.0 despite in many instances being participants. Time differences between the state of Australian SDI and developments in the wider internet are shown in Figure 8-5. Many of the features shown as desirable in 5 years, such as social networking, wikis and mashups, were already available in Australia in the wider SDI that is GeoWeb 2.0⁴³ but supplied by international providers. They provide the context in which the wider Australian community is crowdsourcing geographic information, services and products and becoming Neogeographers.

It is not clear if the CRCSI research agenda aims to work towards integrating these capabilities into Australian institutional SDI and, if so, how it would attract the users from the wider GeoWeb 2.0 to the institutional SDI. It is unlikely that the institutional SDI within Australia will be able to provide a technological product more attractive than the dominant competitors such as Google, Microsoft, Twitter or Facebook. West commented that arguably it does not matter, as the data supplied by the institutional SDIs is authoritative and the data to use for legal reasons. Those who rely on data from these other organisations have no legal recompense.

This perspective is, however, complicated by the multiple sources and integration of information. For example, Google has used Australia's Public Sector Mapping Agency data, an authoritative source. Landgate is delivering its data into Google and will use Google Maps Engine for access and search, making the separation increasingly difficult to identify. Such hybrid private / public SDI developments may increase as public agencies face decreasing resources for infrastructure. Launched in 2013, the National Map (Australia 2014) is an excellent example of the integration of private, government and open source GeoWeb 2.0 capabilities.

⁴³ The time line is misleading as many features emerged earlier than depicted, e.g. mapping mashups appeared in 2005, but has been included as it appeared in the CRCSI research agenda

Figure 8-5: CRCSI report diagram showing Australian and New Zealand SDI development in relation to wider internet developments.



Source: West (2012) and McMeekin (2012)

The question this raises is whether the Government has a responsibility to protect Australians from circumstances they don't fully understand. An analogy is responding to cigarette advertising and sales through the approach of "buyer beware". The community may only consider such abrogation of responsibility unacceptable once they fully understand the issues.

If future SDI is to be more a mix of commercial and institutional resources a question to be addressed is what should be the responsibility of government? Should it supply the infrastructure and data or rather only have a governance role, oversight, regulation, quality control, education, awareness, and addressing imbalances such as from market failures? These issues relate back to what the authoritative data are that crowdsourced data will be integrated with. If some of it is available in free services such as Google Maps and Twitter, then do the institutions also need to hold it or only have a governance role? Where security and privacy are at stake, ownership and control is important, but the data are more akin to proprietary than authoritative data. There is another research agenda that needs to consider this context. There are many issues to be navigated in supplying data to entities such as Google, where exchanges

of resources may not be as equal as the public good should require. British Columbia had to pay for data they had supplied to Google after an initial agreement lapsed (Leszczynski 2011, p11). West agreed that social factors might influence such decisions and may be part of the research project around crowdsourcing currently developed by Femke Reitsma at the University of Canterbury, New Zealand.

These social factors include issues of access, literacy, security, privacy, ownership and trust. Not giving equal emphasis to social factors influencing the crowdsourcing of information exposes the CRCSI program to the risks of creating the perfect technological solution but one in which the crowd cannot or does not want to participate. West agreed this was possible, observing much of the so-called volunteered information isn't really volunteered but acquired. For example, this occurs when Twitter feeds are mined for information by organisations but the information provider is unaware of this, such as during the London riots using the Twitter API. Crowdsourcing information that is acquired has been termed "contributed geographic information" to acknowledge that it has not necessarily been volunteered (Harvey 2013). For information intentionally volunteered to an organisation to correct errors, social factors are important and hence the CRCSI crowd-sourcing project would have an active user group involved.

8.2.4 CRCSI Summary

Overall I found the CRCSI crowdsourcing research agenda to reflect the perspectives and interests of the institutions involved in SDI development, mainly government and research organisations. Crowdsourced information is considered from the perspective of its value to the SDI their organisations promote. This is ostensibly necessary and motivated towards improving the value of institutional SDI for the broader community. The factors are also influenced by the backgrounds of those leading the research with an emphasis on the technology over the social. This arises from a view of technological factors as foundational to capability. It is, however, a partial view that does not consider directly the needs of those supplying the crowdsourced information. This can be perceived as exploitative, but also may not capture the full value to society of crowdsourcing or address potential undesirable outcomes.

It should be of great concern to Australians that most of the geographic information they contribute and volunteer is done in contexts that are outside of Australian ownership, law and control, never mind that of their regional or local community. Without consideration of these

issues, the research agenda may inadvertently contribute to making it easier for Australians to give away information threatening local, regional and national privacy, security and values. Attaining the social benefits of spatially enabling Australian society requires that people can contribute and volunteer information, collaborate and be Neogeographers, safely, securely and without exposing private or proprietary information. This is a role that probably only Australian institutional SDI's can provide, supported by a CRCSI research agenda. Technological research is necessary, but alone it is not sufficient to inform what is a socio-technological phenomenon.

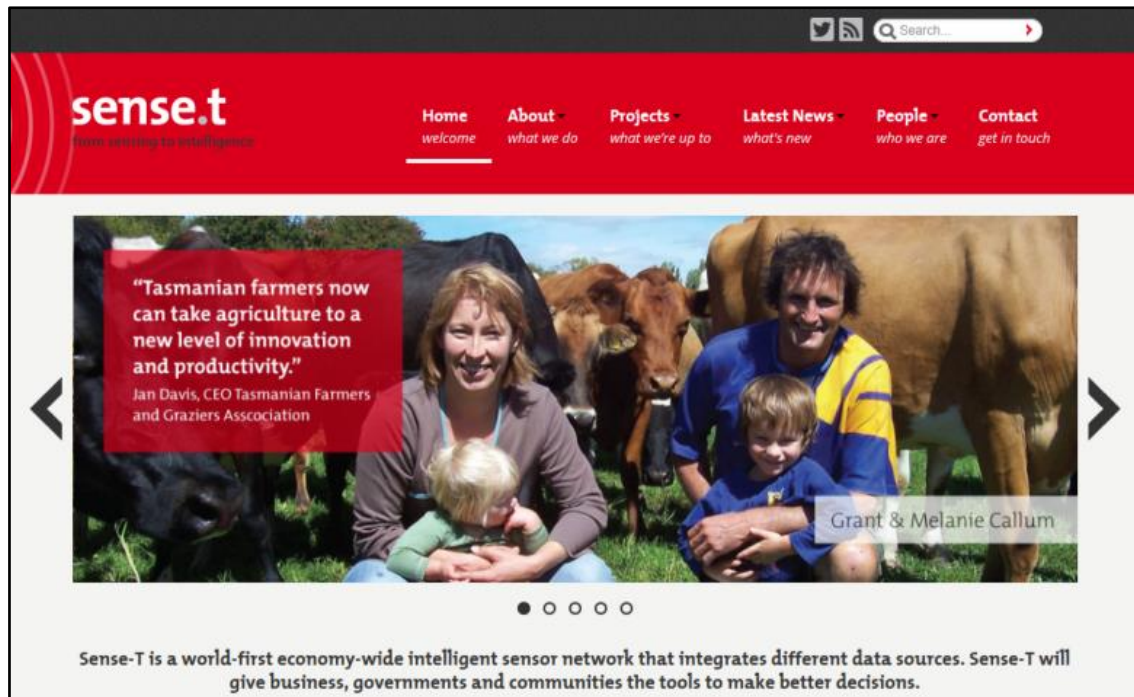
8.3 SenseT develops

At the time of first writing about the SenseT M&E workshop in March 2013, I reviewed again the SenseT website. I noticed that very few of the results of early SenseT research were incorporated or manifest in the project descriptions. What was very noticeable was the prominent incorporation of people into the imagery on the home page, implying a new emphasis on social or people related outcomes and inclusion. This contrasted with the earlier emphasis on physical environments, machine collected data and expert construction of knowledge. In the website imagery (Figure 8-6, Figure 8-7) people are very much in the forefront, they are identifiable as individuals, smiling and relaxed, together with family members, still in productive environments but the technology is noticeable absent. As part of the conduct of my Participant Action Research methodology my report on the M&E workshop was provided to a SenseT program member.

8.3.1 A key informant's perspective

The evening after reviewing the website I met a senior SenseT staff member, Rolf, at a social function and mentioned having seen the web page. Rolf asked why I was viewing the web page as it seemed unusual and this led to a long conversation regarding SenseT. I sent Rolf the document with my observations of SenseT and then had an in-depth meeting regarding the document and SenseT. Methodologically this is very interesting as the initial interaction was totally unplanned but Rolf's input provided rich insights into SenseT. It is another example of the internet breaking down the barriers between research and personal sites, and the different identities we all have in these contexts. The following contains the essence of our conversation and meeting together with my subsequent analysis and comment.

Figure 8-6: SenseT website home page imagery - smiley farming family



Source: (SenseT 2013a)

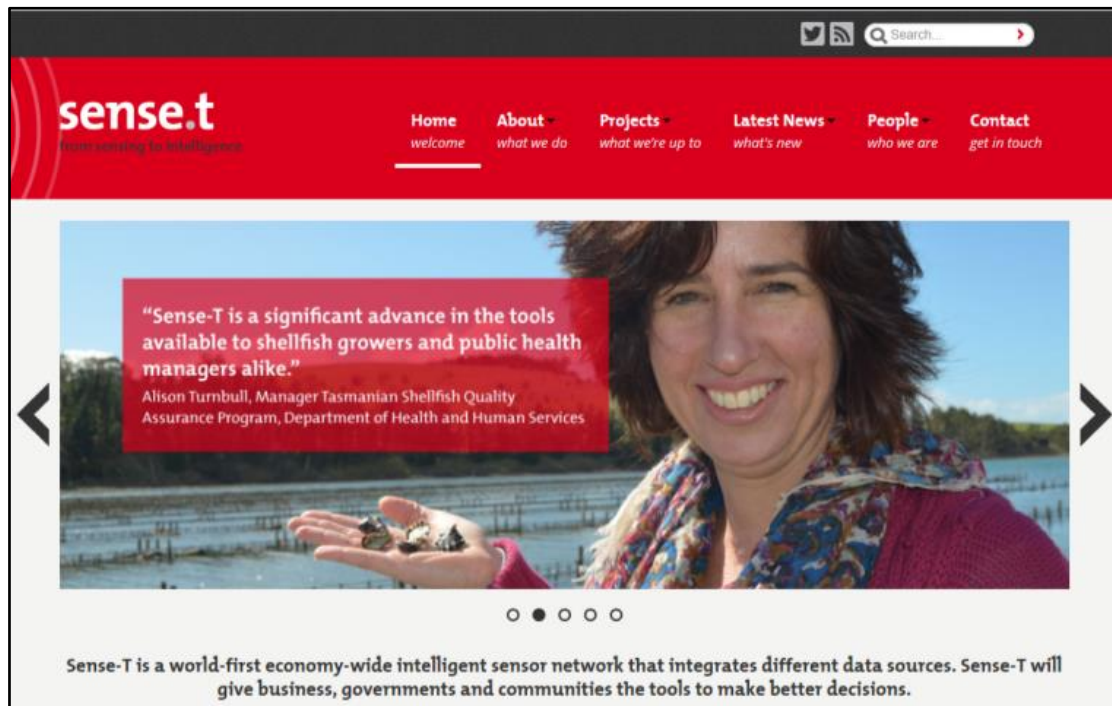
I explained my interest in SenseT and my observation that SenseT was incorporating Geospatial capabilities but not the Web 2.0 paradigm, being mostly conceived as a one way flow of information (Web 1.0). Rolf explained SenseT as aimed at businesses not at consumers, and focussed on making available terabytes of information within research organisations (such as CSIRO and University of Tasmania) and Government departments such as DPIPW, and sharing this with each other and the business community to improve community outcomes through improved business practice. Integrating the data alone was quite a difficult goal. My mention of geospatial referencing as a powerful way to integrate disparate datasets, and getting people to “geotag” information could help this, led to a discussion on the Web 2.0 phenomenon.

Rolf related his previous experience in a Web 2.0 company and enthusiasm for its possibilities at the time, but doubted the continued relevance of the Web 2.0 concept. To illustrate this he supplied a Google graph of searches relating to the term (

Figure 8-8), depicting its search popularity from 2004, escalating in 2005, peaking in 2007 and then gradually declining. Rolf wondered if the internet was moving into the next phase of Web 3.0 or perhaps the Semantic Web. I thought the two were fundamentally different, with Web

2.0 about including people, and Web 3.0 / Semantic Web about developing the machine capability to process the “Big Data” thereby produced.

Figure 8-7: SenseT webpage - happily holding healthy oysters.



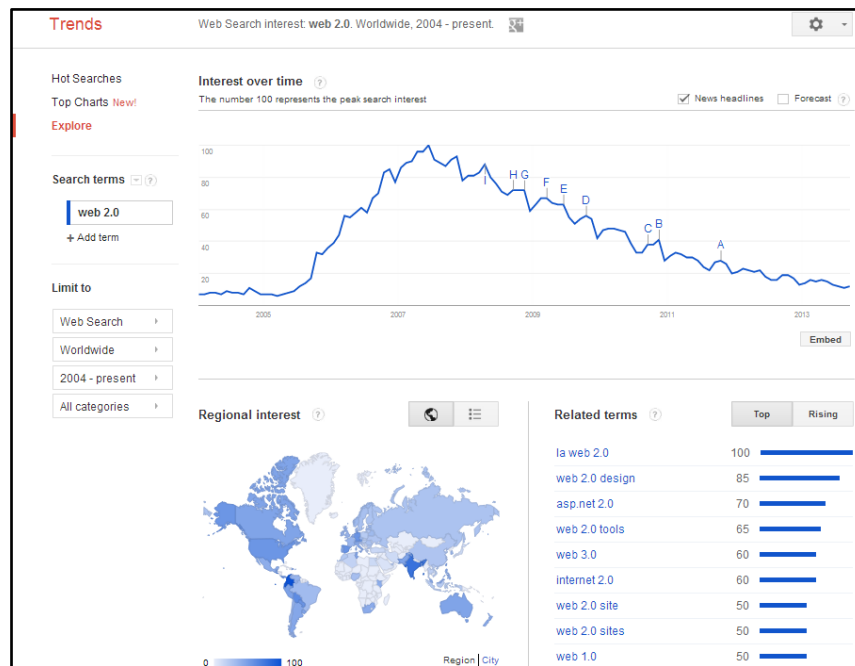
Source: (SenseT 2013a)

I responded that regardless of changing usage, the term Web 2.0 is extensively referenced in relevant literature and discourses as foundational. We then discussed how the term had generated derivatives such as Gov 2.0, related practices such as tagging and crowdsourcing, and how Web 2.0 had possibly been subsumed into other concepts such as New media. These discussions catalysed my conviction that a full articulation of different terminology would provide greater definition to the Web 2.0 concept. We also discussed how concepts such as “Web 3.0” and “Semantic Web” had not become as widely adopted as Web 2.0, except perhaps for the recent adoption of “Big Data”. Rolf questioned the relevance of Web 2.0 as an analytical framework with which to assess SenseT. He argued it was too broad to provide sufficient focus and explained the three main concepts that were relevant to SenseT:

1. the inclusion of people
2. the web as a platform and
3. data, especially big data, open data, data reuse and re-purposing.

I now note how these are also identified as components of Web 2.0 (O'Reilly 2007, Anderson 2007, 2012). We both agreed, however, that Web 2.0 had not gained the prominence in Australia it had in North America.

Figure 8-8: Google Trends search for use of the term “Web 2.0”,



Source: (Google 2013b)

Discussions of the value of Web 2.0 integration included questions regarding which Web 2.0 characteristics are useful. Rolf questioned how useful tagging was and thought the amount of data gleaned from incorporating Social media would be limited. For example, Rolf doubted the usefulness of a small number of people (around 100) contributing data on municipal issues to a local council. We also discussed the idea of openness as an indicator of Web 2.0 and whether Amazon's practice of allowing user contributions could be considered a type of openness.

These discussions were interesting when juxtaposed to documents Rolf had brought to our meeting. The SenseT media release entitled "Tasmania named national HQ for digital services" (SenseT 2013b) named Dr Nicholas Gruen as the Chair of a new "Digital Services for Sustainable Development Innovation Partnership" and "spearheading a digital revolution in Tasmania, with SenseT as the central innovation resource". Dr Gruen was previously Chair of the Gov 2.0 Taskforce, and his writing makes reference to the importance of Web 2.0 (Gruen

2012). Senator Kate Lundy who opened the launch of the partnership was also lauded for her use of Web 2.0:

Lundy has gained broad respect from the information and communications technology sector ... for her creative use of Web 2 social networking tools in contributing to the Government 2.0 Taskforce ... she received global recognition for her innovative online leadership in working towards open and participatory e-government in Australia when she was selected as the winner of the International eDemocracy award at the 11th World eDemocracy Forum (Fell 2010, p.53.1).

Key leadership and champions of SenseT and related initiatives have careers steeped in a Web 2.0 culture. Dr Gruen made the relationship explicit with his clear linking of SenseT to iconic Web 2.0 platforms:

With Sense-T connecting the disparate sensors around Tasmania into a general purpose platform, the data can be used and reused endlessly, leading to the massive escalation of value we see in other platforms – like Google, Facebook, Twitter and Wikipedia. With Sense-T as the connecting tissue for the initiative we should see some great opportunities for digital services providers and their customers (SenseT 2013b).

Whether allowing “the data to be used and reused endlessly” will achieve the stated aim remains to be seen. There are perhaps other characteristics of the stated Web 2.0 platforms that are also necessary, such as ease of use, support of social networking and other types of “openness”.

Rolf thought GeoWeb 2.0 was significant enough to be considered independently of Web 2.0, rather than as a subset. We discussed enabling elements such as GPS and mobile computing that are not part of Web 2.0. GeoWeb 2.0 is only then partly a child of Web 2.0, with the origins of other components such as GIS, Geobrowsers, remote sensing, and geodetics elsewhere. Rolf was unaware Google were crowdsourcing geographic information with its Google Map Maker (Google 2013a) platform and hence could be considered a GeoWeb 2.0 platform. The value of geospatial technology and information for SenseT was undisputed, but I did not gain a clear impression of how that would manifest.

As well as the political imperatives explained in the M&E workshop, these discussions revealed the initial focus of SenseT as determined by many practical realities that included available resources and current core strengths. The immediate need was to make more open the data held by research and government institutions, and this was a considerable challenge. An understanding of Web 2.0 existed within the SenseT community and there is a possibility that

it may evolve to incorporate more Web 2.0 capabilities. The relevance, definition and significance of Web 2.0 are, however, not clear and are contested.

“Openness” as a defining feature of Web 2.0 was challenged, and if openness was useful as an indicator of the degree to which SenseT would incorporate GeoWeb 2.0. SenseT was incorporating Web 2.0 characteristics, such as using the web as a platform and aiming to make data available for reuse; but it was not possible to incorporate all Web 2.0 characteristics and not needed. Rolf also asserted that SenseT was participatory in including researchers, industry and (small) businesses in its development. This is true and shows that participation and inclusion are relative concepts with degrees, as is openness. Overall Rolf was not sure my observations of whether SenseT was incorporating the (Geo)Web 2.0 were of concern or relevance to SenseT.

Different perspectives regarding the nature and relevance of Web 2.0 are influencing the degree of its usage by SenseT. By association this extends to GeoWeb 2.0, but less so to geospatial technologies and information, for which the value was recognised. SenseT has a clear purpose to enable broader sharing of the information it creates and collects and is incorporating capabilities and principles associated with Web 2.0. At this stage this information is that possessed and created by its infrastructure and partners. This does not appear to include information crowdsourced or volunteered by the wider community, that could be obtained and shared through additional (Geo) Web 2.0 capabilities.

8.3.2 Digital disruption is good - just believe it!

It was in this context of different perspectives on the nature of Web 2.0 and the value of different components that I was perplexed by the SenseT event “The World Bank Eye on Tasmanian Technology Disruptors” on 25 March 2014 (UTAS 2014). The essence of the event was that emerging innovative technologies such as SenseT are disruptive, and this is a good thing. This public lecture discussion was with the Chief Innovation Officer in Global Technology Development at the World Bank, Chris Vein. His concluding advice in response to the last question about how the Tasmanian government should ensure such technology was as disruptive as possible, was to “just believe” (01:14:49). This sparked my ire as simplistic and dangerous advice and I wrote a response and posted it on my blog.⁴⁴

⁴⁴ <http://alisterclark.blogspot.com.au/2014/07/just-believe-it-sense-ts-disruption.html>

To be fair, four additional points of advice were included: “act like a platform”, “invite the community in”, “focus on the customer”, and “empower them to do what you need them to do”. Such mantras originate from influential commentators on emerging ICT technologies such as Web 2.0 and related practices such as crowdsourcing, as outlined in Chapters 1 and 2. These reflect an almost utopian view of technology or, at least as observed by Haklay (2013b), an instrumental view of technology, increased openness and sharing of information as necessarily good. Many “goods” may have eventuated but are not evenly distributed, accruing predominantly to those with the access and the resources to make the most of developments. This disparity of access was recognised in the presentation with the example of the existence of 6.8 billion cell phones while 2.5 billion are without adequate sanitation.

The presenter illustrated this well when explaining his confidence in the healthfulness of a Tasmanian SenseT oyster he desires in his hometown in San Francisco. The sensor embedded in the oyster provides undeniable objective data. No longer does he need to believe the hunches of others or the claims of the oyster salesman whose vested interests he suspects. The argument proceeded that if such sensors are applied across supply chains we will all be better off. Those with access to these resources would benefit first from such oysters, while the poor and hungry might need to wait a bit longer for the trickle-down effect. The World Bank is confident that more such disruptions can alleviate extreme poverty by 2030.

What was not acknowledged was how in the process many may also lose. Retailers, musicians and journalists have all felt the effects of previous emerging disruptive technologies, of internet sales and the crowdsourcing of music and citizen journalism. The presenter claimed he was not aware of anyone losing their job because of government open data. In my personal experience redundancies from the efficiencies gained from shared services are attributable to technology. The opening of hospital data was also claimed as beneficial, allowing consumers to compare suppliers based on success rates and cost. Gruen (2012), however, showed how such practice can lead to the perverse outcome of hospitals avoiding high risk patients.

The real situation is much more complex, with many possibilities for unintended outcomes. Macnamara (2010) points out in ‘The 21st Century (R)Evolution’ how neither polarised utopian or dystopian views tell the whole story or are helpful. In ‘The Techno–Human Condition’ Allenby and Sarewitz (2011) describe how unintended and unforeseen consequences often emerge from technological developments. Barry Jones (1982) alerted Australians to this last century with the cry “Sleepers, Wake!”. Morozov (2013) provides an incisive critique of claims

everything can be fixed through modern technology, captured aptly in his book title “To Save Everything, Click Here”. SenseT also knows this because it was explained during the M&E workshop that new technologies have often been detrimental to (Tasmanian) rural communities:

Stakeholders need to keep in mind that increased use of technology could result in reduced employment in rural areas which has negative impacts on communities, services, wages and social cohesion (SenseT 2012a).

The report is not part of the open data SenseT has chosen to share.

In a private conversation a fellow attendee at the lecture observed that it was time to “stop blowing hot air into SenseT” and move on to a deeper, more nuanced and open debate. Emerging Critical GIS perspectives on the broader implications of Neogeography would inform this debate. By foregrounding the “new” in such technology and practice Leszczynski (2013) traces the way spatial media are depoliticised, technologists avoid responsibility for societal implications and legitimise the proliferation and profitability of location based services.

It is interesting to consider how the scientists in the audience felt about being told to ‘just believe’. In one sense the presenter is right, that belief is crucial, but not because the disruption of SenseT will necessarily be good, but because for humans belief is a powerful motivating force through which we enact and often manifest our beliefs. And we must be cognisant of how worldviews affect what we see, in the words of Pirsig (1991), “seeing is not believing, believing is seeing”. We can believe anything we want, but there are consequences. Identifying consequences is the role for good science and, when people’s lives and livelihoods are involved, this must include social science. This is extremely powerful technology that can be used for good and evil, and to be fair again, the presenter acknowledged this, but didn’t elaborate. In the age of the Anthropocene in which humans may be the dominant planetary force, the power of belief has very high consequences (Allenby & Sarewitz 2011). That the lecture was made publicly available online, and can be commented on, is a step by SenseT towards broader openness. There were, however, no comments when I wrote this, and it is the only information on which the public can comment, publicly, online.

8.4 Top down tentative engagement

My interactions with SenseT highlighted the degree to which the sensor network might incorporate GeoWeb 2.0 developments. There was substantial experience with Web 2.0 capabilities within the project team, but differing perspectives that such incorporation would be of benefit. The perspective of GeoWeb 2.0 held by some SenseT members is partial. It is quite possible that such incorporation is not necessary or possible, and that this will have little bearing on the ability of SenseT to meet its objectives. Subsequent projects (SenseT 2015b) broadened to include research in health, tourism, new financial markets, infrastructure, freight and logistics. In these projects there are indications of GeoWeb 2.0 applications to facilitate community sharing of information. Through the AirRater project (SenseT 2015a) people can use a smart phone app to report their daily symptoms of asthma, allergies and hay fever. The project “Sensing Tourist Travel” (SenseT 2015c) aims to incorporate human values as well as objectively sensed data, similarly using a smart phone app to gather information about tourist’s travel decisions. These are, however, very tentative steps in comparison to the many other existing environmental GeoWeb 2.0 applications.

CRCSI interaction revealed organisational awareness and openness to crowdsourcing and GeoWeb 2.0, but also desires to control interactions. The stakeholders involved seek to integrate community information while asserting and maintaining positions of authority. In 2014 the CRCSI research agenda on crowdsourcing had generated three PhD research projects (West 2014). As well as the continuation of the primary original concern, these projects incorporated wider issues such as bottom-up approaches and the use of trust in quality assessment. The topics were examining how to integrate authoritative and crowdsourced data; crowdsourcing a spatial data infrastructure – a bottom-up approach to SDI; and a trust model for crowdsourced data – crowdsourcing pasture biomass calibrations. All candidates were based at the University of Canterbury, New Zealand with Femke Reitsma.

The implications of the ability to control were highlighted by my experiences in May 2013 with GeoWeb 2.0 platform, FeralScan, when I had submitted observations regarding Myna bird incursions into Tasmania. This action catalysed several interactions with the platform owner, the New South Wales Department of Primary Industries (DPI), and the Tasmanian Department of Primary Industries, Parks, Water and the Environment (DPIPWE). DPIPWE did not want the community submitting observations of Myna birds to FeralScan but instead to report them

via their hotline. Negotiations were conducted between myself, DPIPWE and DPI, the outcome of which was that the information I had volunteered to FeralScan was removed (August 2013). While this can be viewed as a sensible outcome, it also demonstrated how even given the existence of “open” GeoWeb 2.0 platforms, control of information can still be affected by political influence. It reifies the perspective from the CRC SI that government agencies want to retain control of information. Personally, I found the experience dis-empowering and it reduced my motivation to participate in, or trust, FeralScan. Community members that seek to publicise information need to consider how government controlled initiatives can still be mediated.

For my practice the openness of FGW2S still provided a preferable medium, and in September 2013 I detected and removed a Bridal Creeper infestation. Bridal Creeper is a Weed of National Significance and the occurrence represented a completely new incursion and hence of substantial significance. The site and my action was recorded and communicated to stakeholders using the SoOE FGW2S (11/9/2013). That I could personally affect change, communicate the action and thereby transparently gain recognition for this was a powerful motivator. This possibility has far reaching implications for how individuals may be empowered and motivated to act by gaining recognition for their actions. Importantly this significant action involved little cost, relatively simple information exchange and was conducted completely independently from Australian institutional applications.

At around the same time I attended a Big Data workshop. Substantial funding was invested in infrastructure to capture and use Big Data based upon a strongly held belief in its value. While Crampton et al. (Crampton et al. 2013) confirmed the value of large databases of spatially referenced internet content for critical social and spatial analysis, they also recommended a cautious approach and awareness of the potential shortcomings. My experience with the reliability of the wiki statistics discovered in Stage 1 highlighted the requirement for expertise to address such shortcomings. This Big Data infrastructure was made available to those with specific expertise within research organisations, another example of the continuing digital divide. I could not but help wonder if such initiatives missed the potential importance of small, simple data within reach of most the community.

8.5 Summary

This chapter has focussed on describing my engagements with two top-down initiatives and has included interactions with two State government authorities and perspectives from my

practice and a workshop. Stage 2 experiences confirmed GeoWeb 2.0 as variously understood, valued and applied; and openness as a concept with many interpretations. They also revealed how the understanding of and attitudes towards GeoWeb 2.0 affect its manifestation, what and how architectures of participation are created and hence the extent to which the broader community can participate in sharing information relevant to sustainability.

The interaction with the CRCSI revealed the nascent state of research into crowdsourcing in Australia. That a global leader in technology recommended the Tasmanian government should “just believe” in the disruptive good of innovative technology, alerts us to the urgency of an increased understanding of GeoWeb 2.0 and its implications. It also stimulates questions about the extent to which other leaders are proceeding based on belief. It catalysed my search for further information on the basis for Australian perspectives and applications of GeoWeb 2.0, and which I explore in 9.2. This chapter concludes the results of this research.

I now turn in Chapter 9 to a discussion and synthesis of these results, followed by a summary of conclusions in Chapter 10.

Chapter 9 Further discussion and synthesis (2013/14)

This Chapter reviews literature and applications discovered through the Action Research approach, with learnings from the previous work mostly woven into the analysis at a meta level, but also with specific examples from Stage 1 and 2 included. The Chapter is structured in the form of a dialogue. Firstly, in 9.1 the concepts of openness and interactivity are re-examined more closely, and specifically in 9.2 in the context of Australian GeoWeb 2.0 research and applications. In 9.3, I then distil the positive potential of an interactive and open GeoWeb 2.0 for broad environmental information creation and sharing. This positive potential is then balanced in 9.4 by consideration of the barriers to broad participation. This provides the foundation for the synthesis in section 9.5, an evaluation of GeoWeb 2.0 use for environmental sustainability. In 9.6 I draw on complexity theory to highlight the problems and risks involved in making definitive assessments. The final section, 9.7, presents a summary of research outcomes addressing the broader criteria for quality in Action research and final comments on methodology.

9.1 Openness and interactivity revisited

Ideas of openness and interactivity as predominant characteristics of GeoWeb 2.0 were found in the literature and prominent discourses, and substantially influenced how the research was conducted. On closer examination, GeoWeb 2.0 is described variously within the literature. Many authors quote parts of Anderson's (2007) Web 2.0, but emphasise different aspects, add or focus on particular characteristics, such as the three aspects of interactivity, the social dimension and modularity (De Longueville 2010). Also, no consistent or comprehensive understanding of GeoWeb 2.0 was found amongst the research participants. Various levels of understanding are a barrier to communication between potential participant's and researchers and need to be considered when framing research questions and methods.

Towards the end of Stage 1, around mid-2012, I set out to write a more comprehensive review of GeoWeb 2.0. The value of this was thrown into question by Anderson's (2012) publication of an updated and expanded version of his initial report (2007). The updated work retains the essence and expands on the original, and is multidisciplinary and extensive. The retention of the 2007 "iceberg" model of Web 2.0 suggests its robustness as a heuristic. It is arguably the most comprehensive view of Web 2.0 relevant to our view of GeoWeb 2.0. Despite its

significance a review (Gao 2012) considered Anderson's work suitable mostly as an introductory text, and that senior Web science researchers will find it too superficial. Gao suggested sections on ethical issues and information retrieval are needed and, that due to the pace of change, such a text requires continual updating. Such constant change confounds the ability for the wider community to understand the developing GeoWeb 2.0, an aspect contributing to technical limitations on participation uncovered in Stage 1 of this research.

My response was to focus on the concept of openness in the context of Australian environmental GeoWeb 2.0 applications through the publication of the paper "Where 2.0 Australia's environment? Crowdsourcing, VGI and Citizens as Sensors for environmental sustainability" (Clark 2014). The paper reviewed Australian literature and developments in juxtaposition to international literature, highlighting differences in time and place. The Australian focus was to make it relevant to local participants and the community, in the broadest sense. The relevance for a wider audience was to show how perspectives on and manifestations of GeoWeb 2.0 are regionally specific and diverse. The first part of the paper, now incorporated into Chapter 2, described GeoWeb 2.0 as emerging around 2005, and by 2008 the international literature had also described the practices it supports and the potential use for environmental sustainability purposes. The second part focussing on Australian literature and applications is incorporated into sections 9.2 and 9.4.

9.2 Australian research and applications

The first consideration of GeoWeb 2.0 appearing in literature from Australian spatial researchers is Cartwright (2008) on delivering geospatial information with Web 2.0. This first paper does not reference the topics mentioned or references cited in Chapter 2. Cartwright (2009a, 2009b, 2011, 2012) subsequently turned his attention to Mashups, Crowdsourcing and Neocartography, describing the emerging GeoWeb 2.0 and related practices, and the impact on wider society and traditional professional practices. He elaborated on the importance of Application Programming Interfaces (APIs) in enabling map mashups, discussing how this enables far more users to become cartographers and map-makers, an idea he later developed under the title Neocartography (Cartwright 2012). Notable examples cited are environmental activist groups, early adopters utilising Google's platforms in 2005 to highlight "bad developments", and to support forest protest action in 2006 (Cartwright 2009a, 2009b), illustrating how Web 2.0 can be used for "mapping alternative Australian viewpoints" and "magnifying small voices". Despite Cartwright's papers incorporating major GeoWeb 2.0

themes from the international literature, they are little cited within the Australian literature, despite continued community use such as Coal Seam Gas Map.

Regarding environmental applications, it is also at this time that planning commenced for the Atlas of Living Australia (ALA). Background reports provided on the ALA web site (Australia 2011a) describe the major concerns of this implementation of crowdsourcing as the available software (Tann & Flemons 2008), data processing requirements and user needs (Tann, Kelly & Flemons 2008). Again, there is no reference to any of the Web 2.0 or GeoWeb 2.0 literature cited herein. One paper states in its conclusion that “a free and open source strategy (FOSS) ... was foundational” without prior argument or referencing (Belbin 2011). Other key Web 2.0 features include the use of wikis and blogs, but there is also little published on which features are working best for the ALA, other than in the ALA blog and newsletter updates. It is significant that the ALA describes its approach as citizen science, showing that use of GeoWeb 2.0 technologies are also addressed under conceptualisations of practice additional to crowdsourcing, VGI, citizens as sensors or Neogeography. This divergence continued.

9.2.1 Diverse terminology

McDougall (2009) drew attention to how VGI was changing the nature of spatial data infrastructures (SDI). The ability of users to become producers of information changes the power relations between the two, and consequently institutions that traditionally created and maintained SDIs have less control. McDougall also points to the increasing private and commercial interests in SDI, and hence changes in overall motivations from public interest, to private, resonating with Leszczynski's (2011) political economy view of GeoWeb 2.0. The following year McDougall (2010) asks whether users will drive the development of SDIs from information siloes to networks. He concludes that a key difference between government SDI and the new user-centric SDI is the degree of openness, with the former “highly controlled with the degree of access and openness to the public limited” and the latter “open access to view and enter data – Web 2.0” (p. 10, Table 1). This research's use of FGW2S in an open manner highlights that such SDI must be focussed to some degree, or participation is not likely to occur. McDougall subsequently turned his attention to the role of VGI in the Queensland floods (2011a, 2011b) and natural disasters (McDougall 2012).

Ho and Rajabifard (2010) considered how to learn from the crowd by addressing the role of VGI for a spatially enabled society (SES), identifying the origins of VGI as within Web 2.0

technologies, stating these include “geospatial browsers, wikis, mashups and folksonomies” (p. 4). Citing McDougall (2009) and the general literature they emphasised the role of Google Earth in VGI, in particular the release of its API that allows the creation of map mashups. Interestingly, while they then identify a central role for the mashup for engaging with volunteered geographic information, they do not make an association of this practice with the concepts of Neogeography or Neocartography, despite having cited relevant literature.

In these papers, spatial data infrastructures and SES are essentially referring to the developing GeoWeb 2.0. The concept of SES aims to capture the expansion of spatial information infrastructures, predominantly called SDIs, from mostly within the domain of public institutions, to more broadly distributed across the public, private sectors and wider community (Williamson, Rajabifard & Holland 2010). Interestingly, at this time the Australian Department of Defence (2010) mirrors this view of the expanding geospatial domain yet still appears to consider this within their control. There are other names used for similar phenomena: Foth et al. (2009) considers the application of Neogeography tools for engagement of the community in urban planning, but focusses relevant research under the term Urban Informatics (Foth, Choi & Satchell 2011a; Foth et al. 2011b) and New media (Hearn et al. 2009).

The Australian literature demonstrated an early tendency to multiple and diverse conceptualisations and terminology for topics relevant to Web 2.0. Elwood (2008b) identified the importance of naming debates as part of the unfolding discussion in wider literature. If an SES is partly enabled by developments related to Web 2.0, clarification of what these Web 2.0 characteristics are becomes essential to our understanding. For these purposes, definitions of terminology and consistent use are required. Acknowledging the timing of McDougall’s (2009) conference presentation, and that it was not designed for such reflective scrutiny, parts are illustrative of this dilemma, highlighting the confusion that can occur when various terms are used interchangeably to refer to the same phenomenon. Google Earth is referred to as an example of a “platform”, a “publically available spatially enabled application” and a “geographic portal” (pp. 646-647). Other terms used in this context are “open portal”, “public spatial databases” and “Web platform” (pp. 645-647). This may seem pedantic, but there are potentially important distinctions between applications, portals and platforms. This research discovered how assuming a priori knowledge can affect responses from participants and recommends being open to how, when and where participants do respond.

O'Reilly's (2005) original work on Web 2.0 drew attention to the difference between an application and a platform. The former is Web 1.0, while the latter is Web 2.0 and far superior. More recently, Sherratt (2013) elaborated on the distinction between a portal and a platform in the context of Trove, the National Library of Australia's discovery service. An important component of the Trove platform is the use of an API which enables "the creation not only of new content, but the creation of new applications and interfaces" (p. 1). Allowing a greater degree of adaptation can be seen as increased openness, the implications being what Macnamara (2010) refers to as the potential for emergence, an important characteristic of complex adaptive systems.

Recently conducted research on the use of GeoWeb 2.0 in Natural Resource and Catchment Management (Paudyal, McDougall & Apan 2011, 2012a) also highlights how definitional issues can cloud understanding. Paudyal (2012) concluded that:

Regional NRM⁴⁵ bodies are increasingly aware of the freely available/accessible spatial products (eg Google Maps, OpenStreetMap, Wikimapia) and the potential for utilising Social media, Web 2.0/3.0 technologies and more flexible models of spatial services.

and that:

regional NRM bodies have already been using some of the Web 2.0 technologies like blogs and wikis (p.205).

What are the Web 2.0 technologies "like blogs and wikis"? This conclusion was gleaned via a questionnaire, a relevant question being number 14:

Is it possible to utilise Social media (face book, twister (*sic*), etc) web 2.0 technology (wiki, etc) and volunteered geographical information (VGI) (open street map, etc) through the NRM KIN project? If yes, how? (Paudyal 2012, p.242)

Clarity would be improved if we knew what Paudyal considers the difference to be between Web 2.0 and 3.0, or Web 2.0 and Social media. He repeatedly refers to GeoWeb 2.0 with the following statement:

Readily accessible and available spatial technologies like Google Earth, hand-held navigation systems (including smart phones, GPS, etc.), Web 2.0/3.0 technology and Social media (Paudyal 2012, pp. 7,49,53,206).

⁴⁵ NRM refers to Natural Resource Management. The reference is to organisations involved in natural resource management.

Clearer definitions and consistent terminology would help in knowing what understanding of these phenomena was in the minds of respondents when answering this question. In this research, those running Social media workshops stated there was little appreciation of the nature, use or value of interactive online maps amongst attendees.

Other applications referred by participants that frame their efforts to engage the wider public similarly as citizen science are RedMap (IMAS 2010) and MySwan (The University of Melbourne 2011). Unlike the ALA, RedMap did not enlist the community as co-developers of software or use creative commons licensing to foster data sharing, but did incorporate a Facebook presence (Redmap 2014) to foster engagement with and between its community, potentially increasing the level of engagement as per Haklay's (2013a) typology of participation. These provide examples of different types of openness and interactivity that affect participation. The integration of GeoWeb 2.0 platforms with other public Web 2.0 platforms, or Social media, is also evident on the ALA, and is part of a wider trend towards the integration of Social media and mapping platforms, discussed by Sui and Goodchild (2011).

9.2.2 GIS and Social media converge

Recognition of the convergence of GIS and Social media led to a media studies view of Web 2.0 by Jim Macnamara, Professor of Public Communications at the University of Technology Sydney, who offered this list of characteristics (2010):

1. connectivity (similar to “ubiquitous networking”)
2. communication
3. community
4. creativity (similar to “Individual production and user generated content”)
5. co-creativity (similar to “Harnessing the power of the crowd”) and
6. conversations.

While using different terminology from O'Reilly (2005) and Andersen (2007, 2012), it appears substantively similar in many areas. Notably all reference to technology is absent in this list, although Macnamara's definition of Web 2.0 is inclusive (2010):

Increasingly widespread **connectivity** through always-on **open networks** that allow people formerly confined to ‘audiences’ to become producers as well as consumers (what some call prosumers or produsers) resulting in **creativity, diversity and plurality in content**, and facilitating **interactivity** including two-way human to human interaction, **collaboration** with others to pool and share ideas and intellectual property (what Pierre Levy calls collective intelligence) and engage in **co-creativity, community** building, and

communication through **conversation** and **dialogue** between people interacting with **authenticity** (pp. 38-39, emphasis by Macnamara).

In his 2010 analysis of Web 2.0, Macnamara did not consider the relevance of GeoWeb 2.0, but does so later with reference to Google Map Maker's stirring of political tensions when used in mapping North Korea (Macnamara 2012). There are parallels between the above definition and Warf and Sui's (2010) description of how Neogeography supports the democratisation of information.

In many ways the Australian environmental examples exhibit openness and interactivity, but whether this results in Macnamara's (2010) "creativity, diversity and plurality of content" is more difficult to assess. Within citizen science applications, the information that can be volunteered is strictly controlled, with limited options for free text and user generated naming or tagging. Despite this control the Feralscan and Birddata examples illustrate how data quality still occur examples. Allowing volunteers to tag species with their own names, generating folksonomies, would wreak havoc with the well-established classification system of plant and animal taxonomy. In these cases, this sort of openness is considered antithetical to the purpose, but crowdsourcing and enlisting citizens as sensors to VGI can still be implemented. Creativity, diversity and plurality of content can be considered to occur, such as through allowing collaboration in developing open source software, but it is within a subject matter and discipline domain. Given these issues and the problem of achieving participation with more open platforms found in this research, Macnamara's (2010) ideal, similar to Haklay's (2013a) level of extreme citizen, is not apparent in Australian applications.

In Australia, the role of the citizens and crowds is primarily as suppliers of data and perhaps information, with limited roles in the creation of resultant knowledge or even wisdom. This approach is mainly aimed at increasing the efficiency of existing scientific disciplines and approaches, rather than at the democratisation of information production "in which the sovereign power resides with the people as a whole" and includes "participation, equality, the right to influence decision making, support to individual and group rights, access to resources and opportunities etc." (Haklay 2013b, p.56). When I asked RedMap about opportunities for participants to contribute their knowledge as well as data, they thought it was possible, but getting other scientist to accept citizens could collect accurate data alone was a challenge. Haklay (2013a) identified professional scientist's acceptance of the value VGI from citizen scientists as a cultural and conceptual challenge limiting the level of participant engagement.

The role of users is, however, broadened where sites integrate with other Social media, such as RedMap's use of Facebook, in which freer, more open dialogues, conversations and community building can occur. Such activities do not fit neatly into Haklay's (2013a) typology of citizen science, but they can provide opportunities for knowledge and community building, leading to collaborative problem definition. Assessments of degrees of interactivity and openness become increasingly difficult as such integration blurs the boundaries between platforms.

Notable though is the focus on limited subject matter, often single physical environmental phenomenon: other examples include FeralScan (IACRC 2011a) for managing feral animals, the North Australian Fire Information (NAFI) (NAFI 2014) about fire in the north of Australia and Birddata (BirdLife Australia 2014), crowdsourcing information relating to birds. Environmental sustainability involves the management of many phenomena, often acting together in complex ways. For example, an environmental manager would be interested in how fire may be interacting with biodiversity and feral animals and require some way of integrating information in separate platforms such as NAFI, FeralScan and the ALA. As separate portals, these sites require that the person who volunteers their information structures it on the terms specific to the site. If a person contributes to multiple sites, their information is fragmented across multiple databases. Elwood (2008b), highlighted how this raises questions whether such sites produce unequal power relationships between site creators and the volunteers of information. Not all architectures of participation are equal, or produce equal relationships.

9.2.3 Broader environmental applications

Managing environmental phenomenon also requires the generation and consideration of information relating to values, plans, actions, audits and monitoring. Relevant environmental information crosses many subjects, relates to and is produced by the management cycle (Figure 3-2), and crosses geographical, sectorial and institutional domains. The entwining of environmental concerns with social and economic issues extends the boundary for relevancy outwards yet further. Who decides what constitutes relevant or priority environmental information is apposite for questions regarding investment in such initiatives and how they are structured (Smith & Stirling 2010). Many of the other existing platforms described herein emanate from established institutions, either government or research, with credentials as authorities and substantial control over relevant information. Platform design shows that

priorities are mostly about increasing the efficiency of existing practice. Alternative requirements are explored in other Australian applications.

At a state level, the Victorian Government created wePlan (Parks Victoria 2011) to harness community input into planning for the State's Parks. While the public Website does not incorporate an interactive geospatial component, it is used "behind the scenes" for gathering select community input into landscape values (Brown & Weber 2011). The design of this initiative is informed by the discipline of PPGIS for which the topics of crowdsourcing, volunteering geographic information and citizens acting as sensors should be of interest. However, there is little overlap in the literature cited by Brown and Weber (2011); or de Freitas' (2010) study of the role of public participation, spatial information and GIS in natural resource management of the dry tropical coast, with that relating to crowdsourcing or VGI. This aligns with Haklay's (2013b) observation of "a fundamental difference between the literature about Neogeography and that of Critical GIS and PPGIS", with "the former mostly supporting the instrumentalist view of technology, (while) the latter is well within the critical perspective of technology"(p. 60). This indicates a deeper engagement with the ontological perspectives of platform creators would provide insights into the implications of the respective architectures of participation for the integration of diverse perspectives.

Two other public access examples are the Connecting Country Community Web Mapping portal (Spatial Vision 2012), and Placestories' Digital Landcare (Feral Arts 2008), both collaborative initiatives between community, government and private enterprise. Connecting Country provides a platform "where individuals and community groups can view, create and share information about their local landscape". Placestories is an integrated platform even more broadly defined yet inclusive of environmental management initiatives. It is used by Landcare groups in a context that integrates wider social concerns. These sites are less controlled in ways that the above are not. This allows free text descriptions and a range of different forms of information to be added by attaching documents and other media, such that information about management actions can be communicated. If the transformative or disruptive power of an open and interactive internet also arises from the inclusion of alternative views, allowing the bypassing of traditional controls, where authority is asserted (Goodchild 2009) and reinforced by recognition from the wider community, then of significance in early 2012 was the emergence of two community based initiatives. These were Local Harvest (Ethical Consumer Group 2012), about local food and sustainable food production, and Getup's Coal Seam Gas

Map (Getup! 2012), for those concerned about Coal Seam Gas mining. There are no well-developed ontologies or methodological disciplines for local sustainable food production or for protesting against Coal Seam Gas mining, so other architectures of participation have been developed to accommodate differences in content and modes of expression. The emergence of Local Harvest provided a foretaste of different approaches that can emerge from community-based efforts. An open GeoWeb 2.0 allows multiple architectures of participation for these sites to deal with environmental information that established institutions do not or will not. These applications appear closer to examples of Neogeography than the citizen science applications that mainly incorporate VGI.

Since early 2005 use of GeoWeb 2.0 in Australia has proliferated to support crowdsourcing, citizens acting as sensors and the volunteering of geographic information for a broad range of environmental applications. The developments signal a spreading awareness about GeoWeb 2.0, together with its maturation towards lower barriers to wider use. With continued searching it is possible to find applications across most environmental subject matter, geographic areas, and social groupings, including implementations from community groups, small businesses and individuals, as GeoWeb 2.0 provides the means for people to communicate to their peers on issues important to them and in ways that are meaningful to them. This is the long-tail of the internet that Anderson (2006) and O'Reilly (2005) emphasised, relevant to environmental sustainability; the many small initiatives that collectively are greater than the few large ones. Such groups and individuals are using aspects of GeoWeb 2.0 that are not provided by the established institutional offerings, supporting citizens acting as sensors and volunteering geographical information to pursue their objectives, not just data about the physical environment, but also about issues and impacts, values, actions and solutions, effectively crowdsourcing a broad range of environmental data, information, knowledge and wisdom relevant to sustainability.

GeoWeb 2.0 territory is, however, not clearly bounded and the paths mapping it are many and branching with different names describing the developing interactive internet and spatial technologies. There is no one collective understanding of GeoWeb 2.0, it is nebulous as a concept and this complicates definitive communication. This is similar to the concept of environmental sustainability. Knowing where and what to look at then becomes part of the issue in assessing the developing situation (Elwood 2008b). Brown and Kytta (2014) discuss definitional issues for PPGIS, PGIS and VGI, identifying a key research priority as “the

diversity of definitions and approaches to participatory mapping” (p.122). Adequately defining and describing GeoWeb 2.0 is extremely difficult, given the different topics under which it is studied, interrelationships between contributing components, difficulties of defining boundaries and its dynamism.

9.3 GeoWeb2 potential for sharing information

The combination of Web 2.0 and GeoWeb into GeoWeb 2.0 appears to provide substantial opportunities for addressing environmental information management problems. This is by increasing the availability of diverse and novel information production and sharing capabilities.

9.3.1 Revolutionising information management capabilities

The availability of mobile computers and sensors increasingly facilitate efficient and near ubiquitous data capture, information production and consumption. Free Web 2.0 services (FGW2S) add further capacity to create, store and organise a broad diversity of information in multiple forms, such as spatial, text, imagery and sound. Information can be captured and displayed almost instantaneously, to multiple and global audiences, greatly increasing its immediacy and availability. The time and place of collection is often automatically recorded making its context transparent. FGW2S that are easy to use with no need for specialist programming ability lower the barriers to, or transactions costs for use, and the risks involved in experimenting, potentially supporting broad participation in sharing information. The FGW2S examples provided herein demonstrated the potential to incorporate wider values of community participations.

Use of these FGW2S also demonstrated how mechanisms such as hyperlinking, sharing and embedding allow the easy linking or loose coupling of information and other resources into a network and are an alternative to categorical organisation that is often hierarchical. The community examples provided in Stage 2 demonstrated how networked structure of the internet facilitates peer to peer connections that also arguably reduce the ability of third parties to control and mediate information production and consumption, or maintain asymmetry of access. Published information hence captures the initial intent of the producer and once published is often persistent. Services and resources that are open, for example open information, free and open source software and APIs, rather than rigid and tightly controlled,

extend participation options to adaptation and reuse of information and other resources, and provide the potential for use to be multiplied many times.

The examples provided throughout this research illustrated how location is foundational to environmental information and sustainability and, as so aptly put by Kearns et al. (2003) ‘everything happens somewhere’, GeoWeb’s spatial capabilities add “where” to the interactivity of Web 2.0. Personal navigation devices and GeoWeb platforms facilitate the spatial indexing and representation of information. Online interactive mapping platforms can be used to represent the location of environmental phenomena, issues, relationships and responses at multiple scales from the local to global. Satellite imagery and other spatial information represent this context visually, and are now available with global coverage in online mapping platforms and digital globes. Such spatial representations support analysis and understanding by exposing associations of spatial co-location or proximity between what otherwise might appear disparate observations (Goodchild 2004; Sui 2004). The value of ecosystems is also often strongly context specific (BOM 2013b), including a spatial and social context, as are related spatial data (Crompvoets, de Man & Macharis 2010), such as participants volunteering of information regarding significant trees in Stage 1.

The adoption of a world standard geodetic system assists the integration of diverse information through spatial indexing. Haklay et al. (2008) noted a growing awareness of the importance of spatial indexing for classifying and discovering information. Otherwise incompatible datasets, such as quantitative and qualitative information, fragmented across diverse repositories, can be correlated by spatial and temporal location, (Janelle & Goodchild 2011). This was confirmed herein, with spatial indexing used to integrate qualitative and quantitative information from diverse subject matter. GeoWeb 2.0 provides two means for organising information in addition to categorical classification: networked structures and spatial indexing. Search capability and spatial indexing help make information easily discovered. Geography has become a powerful organising paradigm for information, with space “a solid tangible domain which may be used for facilitating the perception and understanding of other more abstract domains” (Kavouras & Kokla 2011, p.56). These capabilities represent the potential to integrate environmental information for holistic approaches to environmental sustainability.

Within global GeoWeb platforms it is possible to navigate from local to global scales seamlessly and instantaneously, supporting the ability to conceptualise and address environmental management issues at multiple scales (Gunderson, Holling & Light 1995; Harris

2007). The emergence of the global Food Map (7.4) demonstrated this capability. This capability is useful for comparing information across scope and time, accounting for cross boundaries issues and inefficiencies arising from overlaps in information, all issues identified for SOE reporting. This can also empower otherwise locally constrained agents to jump scales, where “individuals operating at one scale circumvent or bypass an intermediary scale of decision” (Johnson & Sieber 2013, p.74). Clarke (2011, p. 320) suggested that the web and emergence of volunteered geographic information were examples of how geography can move to a “hyper-disciplinary model where content, science, analysis and synthesis blur and a new bottom up science can emerge”.

9.3.2 Connecting and collaborating

FGW2S that integrate Social Networking Services (SNS) (Anderson 2007, 2012) allow connections to be made between people to support group formation, information sharing and collaboration. This can occur across barriers of time and space, in real time or asynchronously. When these services are low cost, accessible and persistent, fewer resources are required for group infrastructure to record activities and retain collective memory through member transitions, with the South Hobart Sustainable Community harnessing this potential. Individuals can connect, groups and organisations form, collaborate and demonstrate their interests, purpose, activities and worth, such that individual and small voices are magnified. Informal collectives such as GovHack can form quickly to pool resources to synthesise, aggregate, adapt and reuse open information. Such groups and collectives have greater resources than individuals alone and can facilitate wider community inclusion and participation in environmental sustainability efforts, challenge prevailing dominant views (Coal Seam Gas Map) or provide alternative views (LocalHarvest), solutions, and effect change.

As found by Elwood et al. (2007), the support of collectives can help address some of the limitations on non-expert individual’s ability to use FGW2S other than for simple representations. Support can be from existing government and not-for-profit organisations, community organisations or informal initiatives, such as Govhack and GeoRabble. Each offers advantages and disadvantages. In this research, I found existing formal organisations to be difficult to work with on initiatives outside of their mandate and ontological perspectives, whereas the Social media workshops were individually personalised. The diversity of approaches shows the multiple ways society is responding to GeoWeb 2.0. If these extend to be broadly inclusive and comprehensive it can produce outcomes that are pluralistic, and

environmental sustainability that is relevant across a broad variety of perspectives and localities. As suggested by Haklay (2013b) work is, however, required to ensure this is representative or at least equitable.

Lower transaction costs in accessing and producing information, group formation and collaboration, can lead to leaner, lighter more flexible or informal organisations that are tailored to specific tasks and contexts. With fewer sunk costs in infrastructure, organisations may be able to form and disband more easily. Demonstrations of how such flexible and adaptable organisations can contribute in emergencies (Irons et al. 2015), suggest a wider role for GeoWeb 2.0 applications in fostering community connections for societal resilience in the context of future disruptions such as climate change. With the increasing ease and lower costs of information sharing, existing organisations can increase the participation of stakeholders and the wider community. Through publishing and collaborative capabilities organisations can communicate more fully and widely their purpose, activities and achievements and engage with a diversity of stakeholders that can help the organisation achieve its purpose.

Opportunities to contribute may be as providers of resources such as data, information, knowledge, ideas, finances and services. Citizen science initiatives are good examples: thirty-three presentations at a recent Australian Citizen Science conference (ACSA 2015) reported using some aspect of GeoWeb 2.0. Or it may be as providers of feedback that helps the organisation improve its performance, for example the review of the Caring for Country program (Australia 2012b). Wide exposure of information online means that quality is open to inspection, increasing the potential for issues to be identified. In response to critical comments about its data, the ALA blog cited exposure to crowdsourcing quality control as one of its methods (Belbin 2013). Negative feedback assists in understanding where risks in the operating environment lie, such as from hostile stakeholders. Monitoring the use of online platforms provides implicit feedback that can be interpreted for external interest and finding audiences.

Publishing organisational information makes available resources others may use to contribute to or achieve an organisation's mission independently. For example, when government publishes open information that allows civil society to contribute to "governance". The GovHack initiative demonstrated how this can be put into practice. Additionally, such resources can be used to achieve alternative purposes, unforeseen or unintended by the initial information creator, multiplying the benefits of this information. Openness and publishing can also reduce the control of vested interests within and without organisations that seek to control

or mediate what information is released. Addressing this information asymmetry is beneficial to organisations where access is controlled for purposes that may be different or at odds to the organisation or wider society, by those who seek to protect sectoral interests.

9.3.3 Information availability, accessibility and integration

Allowing more people to create and share, curate and organise relevant data and information adds to our knowledge, reduces the transaction costs involved in creating and managing relevant information and information asymmetry. Openness in the creation and sharing of information can allow the representation of multiple viewpoints, facilitate discussions on these and improve collective and mutual understanding. Information can be about the state of the environment, what people are doing about that state and how they view that state. Individuals and organisations can produce information for environmental sustainability that is locally appropriate, diverse and pluralistic, rather than monolithic and homogenous. GeoWeb 2.0 provides the potential to make available for wide consumption extensive information relevant to environmental sustainability.

Consumers can then discover and access more diverse, timely, information, that is inclusive, pluralistic and mediated by a greater range of people, and for which the context of construction is transparent. There is not one quality for this information, but many qualities making it fit for many purposes. This provides the potential to increase understanding for better decisions and actions, with more nuanced solutions tailored to specific contexts. This can be faster too, when availability is constant⁴⁶ and discovery and access almost instantaneous. Mobile computing provides the resources for information creation and consumption to occur in group settings in real time. Data made available online, not behind institutional boundaries is an opportunity for less duplication, waste, and reducing information asymmetry and accompanying negative externalities on the environment from poor decisions. This is for all levels of society, individuals, groups and collectives, institutions and organisations, states and nations.

GeoWeb 2.0 has the potential to address problems identified for SOE reporting of access to datasets and the often-mutual incompatibility of separate datasets. For those with the access, resources and motivation, the increased availability of information provides opportunities for harvesting, aggregation and synthesis. This may be organisations with mandates to provide information and knowledge at broad scales such as the BOM or SOE agencies. Information

⁴⁶ Several instances of inability to log onto platforms were encountered

can be that volunteered, contributed, crowdsourced, or otherwise collected and published; it can be objective, subjective, quantitative and qualitative, about actions, solutions, visions and ideas. Storage of datasets and information online exposes these globally to those with access to the internet. The standardisation efforts of organisation such as the OGC address the mutual incompatibility of datasets, where information and data are increasingly stored in interoperable formats (De Longueville 2010). The introduction and use of Creative Commons licensing facilitates the legal reuse and adaptation of information (Fitzgerald 2009). Technically this is assisted by Web 2.0 services that support information discovery, sharing, reuse and adaptation, such as search, bookmarking and tagging, linking, embedding and mashups (Anderson 2012). Incorporation of the geographic and social dimensions also aids in the discovery of information most relevant to a location or community (De Longueville 2010). This is exemplified by Google's mantra that 'Google Maps = Google in maps' (Ron 2008 in Sui, Goodchild & Elwood 2012: 3).

Previously, SOE reporting has been essentially a top down approach, necessitating a limited set of issues and indicators that have then required decisions on what aspects of sustainability should be reported and how. Such constraints then create problems of incorporating different perceptions of sustainability and addressing disagreements on what indicators are important. The need to limit the number of indicators has partly been determined by the previous hard copy mediums and available technology that limited the quantity of information that could be processed and communicated, and how it is organised. Digital mediums and improvements in information storage and processing power reduce some of the limitations on information quantity. Networked information organisational structures and spatial indexing provide alternatives to categorical or themed based organisation. The more bottom-up practices of UGC and VGI, crowdsourcing and Neogeography, present the possibility that decisions on what information and indicators are relevant can be made more broadly by the wider community. This support for multiple information sources and broad participation provides the potential to represent the multiple "knowledges" relevant to environmental sustainability. Tagging, folksonomy and mashups can also allow bottom-up information classification, and flexibility in aggregation and summary, for synthesis and analysis by multiple users. Research investigating how SOE indicators can be developed more collaboratively (Graymore 2014; Graymore, Wallis & Richards 2012) and use of GeoWeb 2.0 applications to support the identification of community NRM priorities (Dalhaus et al. 2013) are moves in this direction.

These capabilities also partly address the issue in SOE reporting of which audiences are important and how to reach them.

Another issue identified with SOE reporting was the uncertainty in data arising from a variety of issues, and how to communicate and account for that uncertainty. GeoWeb 2.0 cannot remove uncertainty and may not solve the issue of accounting for uncertainty, but it can make more transparent aspects of uncertainty, as shown in the FeralScan example. Related to uncertainty is bias. It is unlikely that GeoWeb 2.0, crowdsourcing and volunteered geographic information can remove bias. It may in fact introduce a whole range of new bias as crowdsourcing is extended to include socially-distributed curation (Liu 2010) and, as De Longueville (2010) describes, geoportals become community based. However, just as for uncertainty above, it can make bias more transparent, especially when the origin and context of information – who creates it and to where it relates – is made explicit, such as done by TripAdvisor.

The developments outlined in 9.2 support the notion that GeoWeb 2.0 has increased participation in environmental information sharing and consumption, and 9.3 distilled the potential benefits. In Chapter 6, I concluded that broad-based participation in sharing environmental information did not happen in the SoOE, described the barriers and reasons for this, and that low participation rates were also reported in other applications. I now discuss further the issues and barriers with broad participation.

9.4 Barriers to broad participation

This research has found that not all people are similarly motivated to participate in creating and sharing information online. Barriers identified include: having the necessary resources such as time, ability and technology; risks that include threats to privacy and security, protecting intellectual property and loss of control; attitudes such as goal alignment and worldviews; leadership and relationships; and structures.

9.4.1 Resources and risks

While the provision of FGW2S has reduced transaction costs compared to previous media, it has not removed them entirely, and they are potentially displaced by new demands and risks. It may be now easier and cheaper to produce and access information almost globally, but the technology such as computers, telephones and internet connections, are not free are constantly

updated and require a continual investment of resources (Roth et al. 2014). Expertise is required to use this technology and, as GeoWeb 2.0 evolves, the ability to keep up requires constant learning and attention to be able to create, share and distribute information, find and keep audiences. The risk of becoming obsolete, bypassed, redundant or creating stranded assets is very real. New transaction costs have replaced those of the previous media bringing into question notions of net gains. The transactions costs involved in producing information affect the propensity to give away intellectual property and provide open data without a means to recover resources (Paull 2015).

With the advent of big, heterogeneous data, discovering relevant resources amongst the diversity of views and information qualities, privacy and security issues, and being heard are also new transaction costs with potential to create new information asymmetries. With fewer initial controls on information creation, traditional pre-publishing quality assurance of information has often not been undertaken. This delivers information of heterogeneous quality that introduces problems of assessing fitness for other purposes. The quality of information was relative to the initial context and purpose of its creation and hence new abilities are required to select, assess and conduct due diligence on information and resources. Awareness that further quality assessments need to and often occur post publishing and develop over time in GeoWeb 2.0, is essential. New methods, tools and services are available and developing for post-publishing information quality assessment (QA) and curation. Methods include crowdsourcing, using spatial relationships between phenomena, and social relations or reputation.

Crowdsourcing quality is supported by allowing third parties to annotate information with quality assessments that can then be aggregated and summarised. Quality is then determined from diverse perspectives meaning information is likely to have a range of quality assessments, or “qualities” that relate to fitness for different purposes. Where participation is high and diverse this can reflect a greater range of viewpoints. They are not necessarily “better” or more accurate and introduce further problems of the quality of the QA. This is a bottom-up approach to QA compared to previous top-down expert driven QA that does not remove bias, but makes it more transparent.

GeoWeb 2.0 assists QA by making the context of information production more transparent, where context includes geographic, temporal and social. Many sensors routinely time stamp information they collect and online interactive maps make geographic context transparent,

assisting in verification and the assessment of uncertainty (Goodchild & Li 2012). Despite humanity's power in the Anthropocene to engineer the planet, there are relationships between phenomenon that remain true; water does not yet flow uphill unaided, terrestrial animals do not occur in the sea. Online services and tools that allow the crowdsourcing of social status or reputation to occur, are important where consumers cannot conduct due diligence themselves but rely on recommendations from trusted others. Social Networking Services provide the means to find these others and their recommendations.

I found, and others reported, increasing time demands to discover relevant information amongst the burgeoning quantity and diversity, and managing the increasing quantities of information. Organisations also face increasing resources to conduct quality assurance and semantically mediate, aggregate and synthesise disparate information. This was reported by the BOM for local water authority data; the SOE group and others who were interested in the possibilities, and who also revealed understanding as a barrier. The CRCSI have begun research into how to integrate crowdsourced information of diverse qualities, and identify the need not to reinvent what the private sector is already doing. Groups and organisations also often need to negotiate what information is collectively acceptable (George Patterson Y.R. 2011). Additional transaction costs arise from the risks and liability from misuse or abuse of used, reused, adapted open information. Due to their limited role as information publishers prior to Web 2.0, individuals and informal collectives had lower exposure to issues of liability, privacy and security.

Many of the above are new demands and risks that create new transaction costs attending the production and consumption of information online that need to be understood and managed. Rogers' (2010) Diffusion of Innovations theory suggests that those who are adopting new GeoWeb 2.0 technologies first, the innovators and early adopters, may be discounting these transaction costs due to their higher risk tolerance and resources that allow them to absorb failures. The community group members described in 7.1 were definitely relatively well resourced, while Carl's (7.4) lack of resources was balanced by a high ideological commitment. The consequences of higher transaction costs are more significant for later adopters inhibiting their participation. For broad participation information producers and consumers in GeoWeb 2.0 will require new awareness and skills to manage risk.

9.4.2 Attitudes, culture, leadership, and relationships

Individual's awareness of the possibilities and opportunities of GeoWeb 2.0 influenced participation. This is in turn influenced by available descriptions of what GeoWeb 2.0 is and can be. The previous section outlined the lower comparative level and fragmentation of understanding amongst the Australian academe. In Stage 2 engagements, an emphasis on popular Social media did not include the importance of maps and many other Web 2.0 services. Awareness was found to be an issue for older people, such as within Landcare groups and the Social media workshops, but surprisingly low levels of awareness were also found with University of Tasmania students I presented to, and reported by Macnamara (2010). It is not possible to be aware of all the internet's offerings due to its size, complexity and constant change. How to understand and work with the evolving internet and GeoWeb 2.0 is an issue that affects participation. In groups this was influenced by the least able members.

The motivation to publish and consume information was also found to be affected by perceived return that includes financial, status, opportunities or satisfaction confirming findings by Coleman, Georgiadou & Labonte (2009). The cost of resources and potential risks represent higher transaction costs affecting the relative value of the potential benefit to be gained from participation, which in turn require higher corresponding perceived returns for the costs versus benefits to become favourable. Perceived benefit must be considered in the context of potential risks that include loss of privacy, security, intellectual property, control, continuity, stability and possible liability.

Motivation was also influenced by the purpose for participation. Where there is no direct recompense such as money, giving away intellectual property for no reward is demotivating (Budhathoki 2010). Alignment with the goal or vision that the information sharing will contribute to is an important part of motivation. A vision must be large enough to be worth doing but small enough to be achievable. Other motivators beyond money and goal alignment are the attainment of notoriety or reputation, status, and belonging. Ideology or attitude is important, for example for some, such as participants at GovHack, open information is a desirable end, while others wish to spend less time with computers.

For groups and collectives, motivation is affected by individual attitudes but also the collective culture, where agreement is required on such things as purpose and who can publish open information on behalf of the collective. Australian government organisations were identified

as having a culture of control (West 2012) and risk aversion (Australia 2012a) that inhibits sharing open information. It is difficult to tease apart this culture from real concerns. The potential for liability or misuse of open information either intentionally or unwittingly due to inaccuracies or misunderstandings, acts as an inhibitor on open information sharing (George Patterson Y.R. 2011). Being open and transparent can expose information quality issues, inefficiency, or poor practice that affects a group's credibility and reputation. Open information can create new demands to communicate and collaborate. Interactions in this research showed loss of control is also associated with loss of authority, mandate and employment if an organisation's role is subsumed by others.

The acceptance of crowdsourced information is also affected by attitude, beliefs and culture. A worldview can discount the value of non-expert information and knowledge (Lane et al. 2011). This can be expressed through politics that determines what and whose information is acceptable and favoured, such as in SenseT, through policy such as Gov 2.0, and law such as China's internet restrictions. Acceptance of the validity of outsider's information and views can also be a matter of degree, such as in citizen science initiatives that control what and how information is consumed. This is done on the basis that information from non-expert volunteers is otherwise of insufficient quality unless adequately controlled. It does, however, create and maintain unequal relationships, with volunteers positioned as creators of data and perhaps information and less so knowledge and wisdom. The ease of crowdsourced information production has led to its perception as of less value than other forms that required more individual effort (Denniss 2011), in this case the relative value of email submissions compared to written letters.

Leadership was found to strongly influence participation throughout the research; my leadership within the SoOE, individuals with community-based initiatives and senior personnel within organisations. The attitudes of these leaders, how they view and represent GeoWeb 2.0 and potential participation are crucial, the role of belief becomes significant and those of leaders need to be based upon solid foundations. The critical examination and challenging of the basis of beliefs expounded by leaders such as Chris Vein is crucial. Related to leadership are relationships, and for my participation and those of others the relationships between us were crucial. In most instances, I knew participants previously, and for others I was introduced through another relationship.

9.4.3 Structures

Different socio-political contexts suggest GeoWeb 2.0 is likely to manifest differently in the Australian context compared to overseas (Elwood, Goodchild & Sui 2013). Australia does not have large ICT companies such as those of North America that were the forerunners of GeoWeb 2.0. In Australia, organisations with sufficient resources to create and run large GeoWeb 2.0 platforms are mainly publicly funded Government and research organisations. These have fundamentally different mandates and drivers. For North American commercial companies profit motivates engaging consumers, whereas publicly funded institutions have to navigate complex political issues partly influenced by public concerns such as privacy, security and information quality. As public institutions, it is questionable whether the commercial drivers motivating consumer engagement and feedback for product improvement, cited by O'Reilly, are as important in Australia as political drivers. That said, GeoWeb 2.0 companies have had to navigate political issues, such as Google's Map representation of disputed country boundaries, but they are still immune to many of the political pressures faced by government. Simple public/private dichotomies are, however, difficult to establish in GeoWeb 2.0, where many partnerships exist and boundaries are blurred through integration.

Australian government developments are also complicated by the number of institutions involved, through which policy positions must be developed, negotiated, and persist in changing political regimes. In Australia, Web 2.0 is mostly articulated through the Governments open information agenda and Gov 2.0, and carriage of this occurs across multiple organisations. Geospatial development then occurs in different organisations. Hence, gaining an overall perspective on GeoWeb 2.0 entails the cooperation of many disparate entities.

Overall, while GeoWeb 2.0 presents considerable potential for environmental information sharing, broad-based participation did not occur in the SoOE, was not identified in current Australian applications, and many barriers exist to realising the potential. In this context, I now continue to evaluate GeoWeb 2.0 use for sustainability.

9.5 Value of GeoWeb 2.0 use for environmental sustainability

There is a great deal of inter-site variability in the way GeoWeb 2.0 is implemented across environmental applications in Australia. What is informing this use and perhaps more importantly, whether such use is likely to be beneficially transformative or otherwise

disruptive, as has been observed elsewhere, is difficult to ascertain. The factors that constitute GeoWeb 2.0 are variously and imprecisely described across the literature, and include a mix of social and technological characteristics. There is little disagreement that interactivity that allows two way communications is a central feature, with some discourses extending this to include openness, with an important consequence of this being its support for creativity, diversity and plurality of content (Macnamara 2010) and the democratisation of information (Warf & Sui 2010). Subsequent literature tempers some of the perspectives on openness and democratisation.

9.5.1 Qualifying openness and democratisation

Anderson (2012, xxix) qualifies earlier statements on the openness of Web 2.0:

the starting point for understanding Web 2.0 is...the search for ways to successfully monetize the crowd, that is to develop successful business models that harness the huge number of people participating online through Social media and the free-to-use Web 2.0 services, which in turn rely on open standards and technologies of the world wide web.

Even in not for profit applications open to citizen participation, not all benefit from the community and social capital building potential. Cavallo et al.'s (2014) research on participation in e-government suggests the potential existence of a digital divide that is related to the demographic characteristics of cities. Haklay (2013b) challenged the claims to the democratisation of geographic knowledge, such as Warf and Sui's (2010), identifying that those making use of GeoWeb 2.0, the Neogeographers, were from a narrow demographic, located in affluent societies, educated, and male, and that:

“... to fulfil the democratisation potential of neogeographic practices, a concerted effort is required to integrate new groups in society in the design and development of technological systems and objects” (p.67).

How this concerted effort should manifest is not clear and is confounded by many issues. Australian institutions are using GeoWeb 2.0 to engage participants to different degrees, but it is difficult to ascertain the basis of their decisions. Some see VGI, citizen science and crowdsourcing as a means to reduce costs and increase efficiency of practice. They perceive this to be of value to their objectives which are in turn aimed at the good of society, but such efforts focus on furthering institutional interests and retain control, which creates unequal power relations and raises ethical questions. Young and Gilmore (2014) discuss how the public visibility of information enabled by GeoWeb can have intended consequence when

communities lose control of sensitive information and become open to external exploitation. They argue that strategic privacy is as important as publicity. In Stage 1 I discovered how openness is not always desirable, and in 6.5 explored a methodology for ethical conduct.

Interactive aspects of GeoWeb 2.0 that can be thought of as indicators of openness are used in Australia in environmental applications. The environmental information in these applications remains, however, fragmented by subject matter and to a lesser extent by geographic location, creating problems for holistic management approaches. Emerging web services that allow the integration of information from separate applications, such as provided by theLIST (Tasmanian 2014) and the National map (Australia 2014) may address problems of information silos created by applications focused on limited subject matter.⁴⁷

The overall strategy for interactivity in many environment applications still involves considerable control. Experience with initiatives in Stage 2 showed that from the owners' perspective, this is for perfectly good reasons such as interest area, resources and controlling uncertainty. They are less inclined to openness that supports equal participation and Neogeographic practice, suggesting it is unlikely that public sector organisations will lead the use of GeoWeb 2.0 in revolutionary ways. Mulgan and Albury (2003) identified many barriers to innovation in the public sector, including resources, a risk averse culture, lack of incentives, short term horizons and budgets, and organisational inertia. My experience in this research confirmed some of these but also identified considerable differences between organisations.

There is greater potential to realise the capability of GeoWeb 2.0 to incorporate different worldviews and support multiple representations of these, and hence to reflect the reality of the diversity of the social contexts from which knowledge is constructed. The participation of the community and third sector organisations is important but should not be overstated. Brown and Kyttä (2014, p.135) consider it naïve that greater access to spatial information and processes alone will democratise public sector planning and decision. Better decisions do not necessarily flow from increased information production and availability; this only removes one barrier to poor decisions. Studies of the effect of information about climate change show increasing communication leads to greater polarisation (Hart & Nisbet 2011). There are serious flaws to always assuming that people's action or inaction results from lack of understanding and what Brunk (2006) calls a knowledge deficit. And as the examples herein of the water leak and bridal

⁴⁷ Both of these also recently incorporated a MyMaps facility

creeper demonstrate, the right participation at the right time and place is perhaps more important.

Ascertaining the extent and way interactivity and openness are incorporated requires methodologies for assessing degrees of implementation and the relative merits of different approaches. Similar issues regarding open access publishing have been approached through the proposition of an open index (Paull 2013). To develop such methodologies would require a comprehensive view of the components of GeoWeb 2.0, and I have shown above how this is not available. Even given suitable methodologies, making assessments is problematic as integration between separate sites presents difficulties in drawing boundaries. This suggests that it is necessary to take a wider view, across multiple sites to assess whether the level of openness and interactivity fosters creativity, diversity and plurality of content.

No one site or platform implements all of the characteristics of GeoWeb 2.0, (that is, are open or interactive in all possible ways); however it is possible to consider that collectively they do. Therefore, assessments of how well the internet supports creativity, diversity and plurality of content, are usefully done at multiple levels. Holistic assessments are however probably unachievable given that the internet extends out almost boundlessly and is in a constant state of flux. Case studies examining how the internet or the GeoWeb does or does not support creativity, diversity and plurality of content would need to be carefully designed, address assumptions about a-priori knowledge of GeoWeb 2.0 and how generalizable results would be beyond the context of application.

Difficult questions for academics, industry and government are then deciding where and how to draw boundaries, and what the indicators are of sufficient openness and interactivity of the right kind to support desired outcome? Governments can both build applications or platforms, such as ALA, and support the community in sharing relevant information using existing online applications and resources. Initiatives such as GovHack (2014), the Landcare Social media manual and Webinar (Landcare Australia 2014), and Social media workshops are evidence of the latter approach. Innovative solutions can emerge: Local Harvest was initially partly resourced by crowdfunding (Ray 2011), a more bottom-up resourcing approach.

9.5.2 Whose information and sustainability?

The above issues raise questions about whether conceptualising and addressing issues at broader scales of time and place, historically the provenance of institutions, are best done

through the creation of separate platforms from those freely available. An alternative is to place no limits, foster openness and harvest or mine the resultant data flood. For example, without a RedMap platform, could relevant information be harvested from Social media or recreational fishing and diving internet sites, as explored by Connors et al. (2012) and Stefanidis et al. (2013)? Could a state of the environment “report” be generated from the long tail of GeoWeb 2.0 sites created as the general community addresses environmental management issues, through businesses, not-for profit and voluntary initiatives, conceptualising issues and solutions creatively and pluralistically? This approach entails less public investment but poses risks relating to information quality, security and privacy.

The role of the geospatial industry and government is not only to create platforms, but also to provide tools, places, resources, expertise and guidance for the wider community, not for a predetermined outcome, but to foster diversity, creativity and plurality. Such a loosening of control in turn raises many other issues, including equity of access, representation, relevance, discovery, quality assurance, authority, privacy and security. How are views at broader scales of time and space generated if the information produced is predominantly heterogeneous, introducing major problems of semantic mediation? Not filtering makes semantic mediation very difficult, but any pre-filtering of information is a simplification that introduces uncertainty, but all information architectures embody different world views and types of uncertainty. Is it still relevant to pursue all views at broader scales to inform top-down strategies, if environmental issues can be addressed from the bottom-up, through self-organisation, peer-to-peer connections, and crowdsourcing? There are many questions that these practices raise and offer challenges to existing roles and authorities.

There is substantial evidence in the form of online applications that the Australian community is well advanced in using GeoWeb 2.0 for crowdsourcing, and engaging citizens acting as sensors to volunteer geographic information relevant to environmental management and sustainability. This use is by government and research institutions, not for profit, advocacy and other community organisations, and individuals and appears to be placing environmental sustainability in Australian’s collective hands. An understanding of where this may lead is essential, as experience in other subject matter domains has shown the potential for beneficial transformation, disruption and undesirable outcomes. Ideally we receive a contribution to this understanding from academic debate and research, however, relative to international developments, Australian academic research into the topics of crowdsourcing, citizens as

sensors and VGI is only beginning. Given that GeoWeb 2.0 is constituted by both social and technological factors, the transferability of international research to the Australian context requires a careful assessment. Crowdsourcing first appeared in the 2012 research agenda of CRC SI (West 2012), with an initial emphasis and primary interest on how crowdsourced information can be integrated with authoritative spatial data infrastructures.

Existing relevant Australian research into these topics and the conditions that foster various manifestations is also occurring in other disciplines and under different conceptualisations. These separate discourses mediate against a holistic view, with each knowledge silo not considering the full implications of such developments acting together and synergistically; a version of Clarke's (2011) hyperdisciplinary model is required. Whether or how such literature is informing Australian environmental applications is also difficult to ascertain. Few of the applications publish the rationale for their design decisions, and of those that are published, there is little reference to the literature describing GeoWeb 2.0. There is a dearth of a holistic or unifying literature relevant to the emerging Australian situation, and much uncertainty about what GeoWeb 2.0 is, does and how it will evolve. Significant literature and many initiatives have been based on assumptions about GeoWeb 2.0 that are not necessarily supportable. A clearer articulation of the phenomenon would lead to better understanding of when uses of (Geo) Web 2.0, its derivatives, components or namesakes, manifest in positive or negative outcomes. However, understanding GeoWeb 2.0 is, as Allenby and Sarewitz (2011) state for technology in general:

“... not just a process of observing something “out there” it is an integrated result of a query, a set of artifacts, and elements of social, economic and psychological and cultural context called forth as a whole” (p.53).

Understanding “openness” in GeoWeb 2.0 is not about technology or culture but about both working together.

Through this research many individual applications, including my own, have been identified demonstrating use of GeoWeb 2.0 for environmental information sharing in support of environmental sustainability. However, the potential for unintended and unimaginable level II and III outcomes as these interact together and with other processes mean it is, therefore, not possible to assume they can either scale up or aggregate to contribute definitively to overall environmental sustainability. I have to heed the warning of Allenby and Sarewitz (2011) that

with complex adaptive systems we cannot extend judgement and analysis beyond the boundaries of the initial query or assessment, and suspend judgement.

Leszczynski & Wilson (2013) called for a broader search for theory relevant to understanding GeoWeb 2.0 and at the outset of this thesis I drew attention to how complexity theory could be used to describe GeoWeb 2.0 as a complex adaptive system. I now explore perspectives from complexity in relation to commercial interests and control of GeoWeb 2.0.

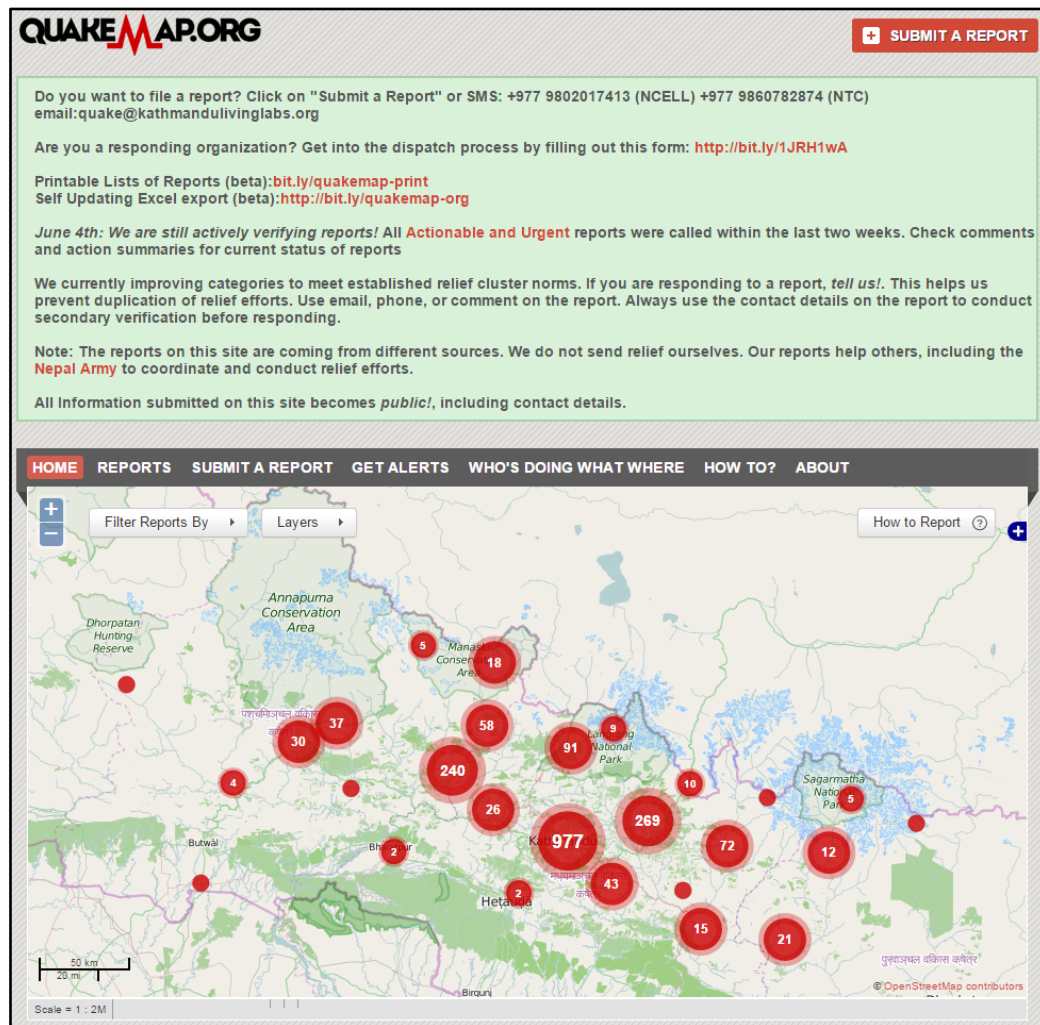
9.6 Complexity, commercial interests and control

Allenby and Sarewitz's (2011) framework of levels of technology manifestation introduced in Chapter 6.3 posits that new technologies and practice can solve existing problems at level I, but create new ones at higher levels of II and III. Complexity theory explains these as emergent properties that resist easy attribution in causal relationships, are often unpredictable and can lead to instability (Flood 2010). Macnamara (2010) identified openness as contributing to the potential for emergence, such as when the capability of GeoWeb 2.0 and widespread distribution of information produces unintended and uncontrollable outcomes. Two approaches for coping with potential emergence from such openness are either more trust and tolerance, or greater governance and rules. The first is bottom-up, cheaper and flexible but risky, the second is top-down, expensive and rigid but appears safer as familiar ground.

In natural disasters and emergencies when greater speed and flexibility is required, necessity and perhaps by default trust, will win over governance. These are, however, also situations ripe for exploitation. GeoWeb 2.0 use for crowdsourced crisis mapping has powerful potential to supply post-disaster information for response efforts (Poblet & Casanovas 2012). Questions about who should exercise and gain from that power, are highlighted by comparing two applications for the recent Nepal Earthquakes, Quakemap (Living Labs 2015) (Figure 9-1) and Tomnod (Tomnod 2015) (Figure 9-2).

Both use online interactive mapping platforms to enlist volunteers and crowdsource geo-information. Which is worthy of our attention, surely disaster victims will benefit from volunteer's time and expertise either way? While similar, closer examination of the ownership, presentation and governance of each platform reveals important distinctions that illuminate wider concerns about disruptive digital technology, and the dangers in "just believing" leaders such as Chris Vein.

Figure 9-1: QuakeMap Nepal earthquake crowdsourcing interface

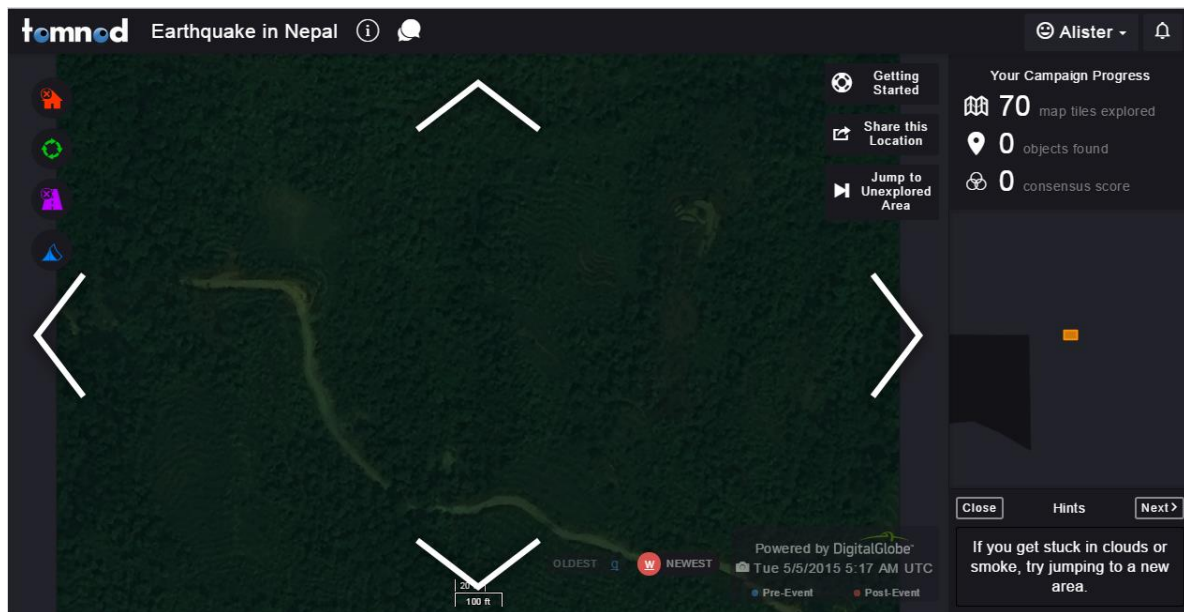


Source: (Living Labs 2015)

Position's (Chester 2015) article "Many eyes make light work" highlighted Tomnod's capabilities. On Tomnod's Nepal Earthquake campaign I could quickly begin assessing satellite imagery for earthquake damage without the need to register, or read a lengthy disclaimer and how-to guide. The interface was easy to use and I was guided by hints and encouraged by messages. Tomnod expertly engages volunteers and uses their time efficiently. Chester cited (p.18) Tomnod's crowd co-ordinator stating they have engaged nearly 2,000,000 volunteers worldwide. The equivalent effort of a professional cartographer was estimated at approximately \$50 / hour. At just one volunteer-hour this equates to 10 years of a full-time-equivalent, and \$100 million worth of effort. Shay Harnoy, CEO and Founder of Tomnod stated that "sometimes we might provide the data for free for the people responding to the event, but for enterprise users we have another curation layer of data that's packaged up for their needs"

(Chester 2015, p.18). There is much to be saved and made through such volunteer efforts but is it completely clear who gains and loses? Tomnod is now owned by Digital Globe, an American commercial vendor of space imagery and geospatial content. Quakemap is created by the Nepalese based not-for-profit organisation Living Labs.

Figure 9-2: Tomnod crowdsourcing interface for Nepal earthquake⁴⁸



(Source: Tomnod 2015)

The urgency and human suffering of disasters breaks down barriers to openness and sharing, and challenges slower due processes and deeper consideration. We are motivated to contribute by the obvious public good and chastened to not waste time in lengthy reflection. Disasters are situations ripe for potential exploitation, those affected are extremely vulnerable. The governance arrangements of not-for-profit of organisations provide some protection. The entrance of commercial organisations in such situations makes it important to question the legitimacy of engaging volunteers in potential profit making enterprises. Boundaries are being crossed and blurred. Transparency is important. Quakemap are transparent about who they are, where the information relates to (Figure 9-1) and what is happening on the ground. With the Tomnod satellite imagery (Figure 9-2) there are no references such as co-ordinates or place names included, we cannot tell if we are volunteering information relating to Nepal's earthquake or some other area of (commercial) interest. What is to stop those with less altruistic

⁴⁸ This is the best quality image that could be obtained

intent from harnessing the technology, and pushing the same psychological buttons to engage erstwhile volunteers to assess and disclose information about people they know nothing about? Should we be demanding a close accounting from Tomnod and Digital Globe: how much volunteer effort is used, who from, and where the results go?

Developed countries such as Australia are not immune to such use of GeoWeb 2.0; applications that utilise the same underlying technology, such as Airbnb and Uber, are challenging local hospitality and taxi industries (Harvey 2014; Logue & Hollerer 2015). Proponents of open information (Houghton 2011) emphasise the potential positive outcomes yet these are likely to flow those who can use the potential – in the above examples to the owners of these platforms who are mostly overseas, and mostly in the technology hubs of North America. It is local businesses, workers and communities that lose. Technologies such as GeoWeb 2.0 are called disruptors that unleash creative destruction whereby the old is destroyed and replaced by the new (Ho 2015), presumably where the latter is better than the former. Ho (2015) asks if the spatial industry is ready for the creative destruction of the disruptive spatial technologies that create new industries but in the process displace the incumbents and their jobs. Why should we care that the jobs of inefficient taxi drivers and hospitality workers are lost if we get cheaper rides and places to stay? Those taxi drivers and hospitality workers are also fathers and mothers that raise families, volunteers that coach football teams and lead scouts, look after the sick and elderly. They constitute our communities and part of its social capital.

Digital inequality: uneven access to the internet, technology, infrastructure, expertise, time and money; for different societies, groups and individuals within societies means uneven access to the power and products of GeoWeb 2.0. Commercial interests motivate attempts at domination. Without equity and or democracy the potential exists for the powerful to use the technology to increase their power. Regardless of how benevolent, capture and control of GeoWeb 2.0 by limited interests concentrates power over the new means of production. Domination by a one worldview, such as rational efficiency over efficacy, may hasten progress in the wrong direction, not actually help decide a new, sustainable direction. Both efficiency and efficacy are needed, not singular narrow views.

In a seeming paradox to the role of openness, Flannery (2010) describes organisation arising from simple rules in communities of super-organisms such as ants, as a property of complexity adaptive systems. Simple rules control interaction, but importantly operate at the micro level, not at the macro level and generate self-organisation from the bottom up, not top down. For

example, new ant homes are decided upon by a “voting” mechanism whereby the site that gets the most visits, as measured by accumulated pheromone trails, is chosen. This is similar to the way search and other Web 2.0 services use the clickstream, links, likes and votes to determine the popularity and hence “quality” of web pages and the information and resources they contain. Is this computer science consciously or unconsciously acting as a complex adaptive system? If it has been consciously designed as suggested by Johnson (2001), is it an indication of what Allenby and Sarewitz (2011) call the move to conscious evolution, in which the role of human belief, politics and agency is strong. The concept of self-organisation does not fully address the purposive roles of individuals and organisations and their ideas, policies and rules. Perhaps what we believe about GeoWeb 2.0 then becomes just as important as the reality, and cause to re-examine Chris Vein’s statement about “just believing” as creating a vision and then working to make it so.

9.7 On methodology

This section summarises the outcomes of this research in relation to Action Research’s broader criteria for validity and quality (as listed in Section 3.2.1). It also summarises several strategies for dealing with online change, and perspectives and boundaries relevant to the research approach taken.

The contributions to action-oriented outcomes include the creation of online resources, influences on other people’s activities, and changes to on-ground environmental conditions. The online resources included the SoOE FGW2S, my blog and other materials posted online that remain accessible as a resource to others. Influences on others included the participants use of FGW2S for their own social enterprise, improving aspects of the South Hobart Sustainable Community embedded map, and presentations on the emerging GeoWeb 2.0 each year to University of Tasmania undergraduate students studying sustainable environmental management. Through my own personal actions, I influenced a water wastage issue and treated an early infestation of Bridal creeper.

Quality as relational praxis was achieved through explicitly structuring the research to be participatory and collaborative, consistently inviting and being open to broad participation, and being transparent with research materials and developments through online publishing. The education of participants and myself demonstrates catalytic validity. For myself, these changes were to both my technical abilities and wider understandings, the latter of which included

changes to my worldview as set out in Chapter 6. Through participation in this research, others learnt about the emerging GeoWeb 2.0 and its possible applications.

The local focus of SoOE, other engagements and the topics of concern, represent results relevant to the local setting and hence the research's democratic validity. Localness was interpreted as relative and operating at various scales from the neighbourhood, through regional to the national level.

The validity of the overall research methodology of AR and PAR as appropriate to context and subject was initially established in Chapter 3. Multiple methods were then used as appropriate to the context, and a range of perspectives ranging from insider to outsider provided multiple sources of data. Detailed records were kept of the research process, reflexivity used to critically examine subjectivity and transparency employed to expose bias. Another contribution of the research to methodology was the experiences in Stage 1 and Stage 2 that demonstrated the importance of offline participation. Therefore, discovering or trying to create forums where these conversations can occur is important in such research. The exploration of how to address issues of informed consent in these contexts as set out in Chapter 6.5 also contributes to process validity.

Quality as plurality of knowing was sought within the constraints of the digital medium by seeking to integrate multiple subject matter and ways of representation. Further, the research was situated across multiple disciplinary domains, environmental, the internet, GIS and Action research, and incorporated perspectives from theory on each of these. Offline participation incorporated other ways of knowing, most importantly participants' experience and tacit knowledge, and this included my own.

The research demonstrates quality as engaging in significant work by addressing issues of significance: environmental sustainability and the implications of an emerging technology. That the research qualifies as emergent enquiry towards enduring consequence, or a new and enduring infrastructure, is difficult to ascertain. The change in my own knowledge and perspectives is deep and lasting. Many of the attempts at engaging with others did not progress in the ways intended. These difficulties demonstrate that what is possible is also constrained by existing structures and power relations. The descriptions of research instances that did not work as intended are important to guide other researchers. They also constituted challenges to reassess situations and assumptions more deeply, and how valuable outcomes are conceived.

It was observed that in several instances the actions of others (Community group members, BOM, CRC SI) progressed independently in directions similar to those proposed, and were of value to those involved.

9.7.1 Change, research position and boundaries

The developing GeoWeb 2.0 operates in a context of rapid change. Several strategies were identified as a practical outcome of the Action Research approach. It is important not to overinvest in expertise or infrastructure; and hence low cost strategies for overcoming technical barriers are necessary. Highlighting, exposing or talking about problems online in a place related to the relevant service can attract the attention of the FGW2S creators who are interested in continual improvement and provide options for feedback. They and other interested stakeholders also provide online help forums and guides, videos, webinars and mailing lists. Social media helps find and curate such sources and provides a bridge to offline resources such as groups, meet-ups and training workshops. These range in formality, with casual groups such as GeoRabble and SocialHob, to slightly more formal processes such as GovHack and Social media workshops. Many of these strategies are not new, but there are potentially more options and the feedback cycle is faster, with the potential that a problem will either be fixed by someone else, or they can help.

Technology also evolves, hence it is tempting to say that action can be delayed until problems are fixed or new technologies are available. Action can be “always beta”, expecting that deficiencies are likely to be addressed by technological advances. Some experiences in this research, such as the KML button and layers in Google, and user tagging in ArcGIS, partly confirmed this and aligned with Boulos’ (2005) prediction that the creation of online maps would become easier without the need for specialist programming expertise. However, other experiences provide the perspective that new capabilities come at the expense of existing features. Not all users will want the same functionality to be upfront and easy to use. The commercial interests of major GeoWeb 2.0 service providers influence them to reflect the requirements of the users from whom they gain resources, while supporting the free use of a diversity of other users becomes a second priority. It is then in this arena that perhaps governments, not for profits and local small commercial providers can provide tailored options. Users can identify the features in the major platforms they want and these public agencies can provide them. They will perhaps always lag, such as theLIST in Tasmania, but should then focus on long term provision of a stable, secure platform tailored to local requirements.

The effects of contingent time and place were limitations over which I largely had no control. Other boundaries I purposefully imposed. An important boundary I imposed was not to undertake any programming, specifically to investigate the claim that Web 2.0 enabled participation by reducing the barriers for non-experts, one of which was the ability to program. It was also part of my positioning in respect to other collaborators – I did not want to become positioned as an expert with a primary role for enablement through programming. Not programming, however, then became a major limiting factor in what I could achieve and how I could participate in certain forums, such as GovHack, and how I was positioned by those who could and would program.

9.8 Summary

This chapter has re-examined the concept of openness more closely in relation to Australian GeoWeb 2.0 research and applications. It argues that ideas of openness as a defining feature had translated across from the international literature into the Australian context. There isn't, however, a unified Australian research literature relevant to GeoWeb 2.0, but rather a diversity occurring under a range of conceptualisations using diverse terminology. Applications of GeoWeb 2.0 features contributing to openness were found to be variously applied, and there is little published on what has informed this diversity. Differences in the Australian context, such as the lack of large commercial ICT companies and the time that features such as creative commons appear, are thought to be important influences.

Large ICT companies support ICT professionals that match the socio-economic profile Shirky (2010) and Haklay (2013a) identify contribute the cognitive surplus fostering the GeoWeb 2.0 and VGI. Creative commons underpin the provision of open data, a foundation of GeoWeb 2.0 and this occurs later in Australia. Mullen et al. (2015) attribute the emergence and growth of OSM as a response to greater restrictions on open geographical data in the UK compared to the US. The uneven release of Google products across the globe, such as Google Map Maker (later in Australia), contribute to global differences in GeoWeb capabilities and VGI production. This increases the relative influence of Australian government organisations, policy and applications that I outlined in Section 5.3.3.

The positive potential of GeoWeb 2.0 for broad environmental information creation and sharing was distilled, and this was then followed and balanced by consideration of the barriers to broad participation. This juxtaposition provided the foundations for an evaluation of

GeoWeb 2.0 use for environmental sustainability, and theoretical perspectives from complexity were explored in relation to commercial interests and control. Finally, the contributions of the research to the broader criteria for quality in AR established in Chapter 3 were presented, together with strategies for dealing with continual change, and perspectives on the implications of research position and boundaries.

The thesis now concludes with a summary of the research findings.

Chapter 10 Conclusions (2014/15)

This research has investigated the potential of the interactive geospatial capabilities of the internet, GeoWeb 2.0, for facilitating broad-based community participation in environmental information sharing and environmental management. The following objectives have been addressed as contributing to this aim:

1. identify issues with traditional environmental information sharing that can be addressed through GeoWeb 2.0
2. assess the potential of free GeoWeb 2.0 services (FGW2S) for community-based sharing of environmental information
3. determine factors influencing participation and use of GeoWeb 2.0 by the broader community and
4. evaluate the use of GeoWeb 2.0 for environmental sustainability.

Issues with traditional environmental information sharing that can be addressed through GeoWeb 2.0 were identified initially in Chapter 2 through a discussion of the nature of sustainability and its information requirements, issues identified in SOE reporting and the capabilities provided by GeoWeb 2.0. In Stage 1 (Chapters 4 and 5), I conducted an initial assessment of the potential of free Web 2.0 services (FGW2S) for community-based sharing of environmental information; and identified factors influencing participation and use of GeoWeb 2.0 by the broader community. The results of Stage 1 were reviewed and reflected upon in Chapter 6. Stage 2 then further examined several bottom-up initiatives (Chapter 7) and two top-down initiatives (Chapter 8) regarding use of GeoWeb 2.0. Chapter 9 discussed the initial research objectives 2-4 in a dialectic that considered the potential of GeoWeb 2.0 against the factors affecting participation and other issues arising from such use, with a synthesis of its potential value for sustainability.

I now summarise my conclusions, and present final comments on the contribution of the research, methodology and future research.

10.1 Environmental sustainability and GeoWeb 2.0

GeoWeb 2.0 has revolutionised information production and sharing, through the creation of novel and diverse information production capabilities. Interactivity, networked structures, spatial indexing and representations are key novel developments. Within the parameters of the digital medium GeoWeb 2.0 provides the potential to represent a diversity of worldviews and

representations. This full capability does not exist within one platform but across GeoWeb 2.0. Rather, the architectures of individual platforms reflect the worldviews of their creators and hence what can be represented and how. Networking and moves to integration, however, blur boundaries and hence distinctions between individual platforms. Initiatives such as Local Harvest, Coal Seam Gas Map and South Hobart Sustainable Community demonstrate the capability to represent multiple versions of sustainability that reflect different worldviews other those of traditional authorities, and are relevant to local geographic and social contexts.

Organisations, businesses, and community groups can use GeoWeb 2.0 to support citizens acting as sensors and volunteering geographical information, effectively crowdsourcing a broad range of environmental information relevant to sustainability. Individuals and groups can use free GeoWeb 2.0 services (FGW2S) independently to create and publish diverse information quickly, widely and without mediation. Without particular expertise, this is, however, limited to simple data and information. Constructing more complex knowledge requires greater effort and resources, which individuals may not easily do through the course of other life demands, reducing their ability to do more than share relatively simple data and information. Where power and influence arise from the ability to construct and publish more complex information and knowledge this will then accrue to those with greater resources. I demonstrated, however, that the sharing of simple representations could still effect environmental change and contribute to sustainability. To assess the full implications of the effectiveness of such practice, comparisons against other method of sharing need to be undertaken.

The collaborative capabilities of GeoWeb 2.0 can be used to create connections between people to support group formation, information sharing and collaboration across barriers of time and space, in real time or asynchronously. Through such collaboration, organisations can become more transparent, accountable, engaged, relevant and responsive and more effective in contributing to environmental sustainability. Lowering of transaction costs for group formation and collaboration can foster flexible informal collectives, groups and organisations tailored to specific tasks and contexts, able to form and disband more easily. Allowing more people to create and share environmental information increases the availability of information relevant to environmental sustainability. Openness in the creation and sharing of information allows the representation of multiple viewpoints, while collaborative capabilities facilitate discussions and collective action. Information consumers can discover and access more diverse and timely

information that is inclusive, pluralistic and mediated by a greater range of people, and for which the context of construction is transparent. There is not one quality for this information, but many qualities making it fit for many purposes. Spatial indexing and representations allow information to be placed in context, supporting spatial reasoning and the assessment of quality. This can increase understanding for better decisions and actions, with more nuanced solutions tailored to specific contexts.

However, while part of the revolutionising potential involves lowering barriers to participation in broad-based information sharing, barriers still exist and new ones emerge. Potential risks and other barriers to online participation were identified and operate at multiple levels. These are threats to personal privacy, security and reputation, loss of intellectual property, increasing demands for information and collaboration, competition and challenges to existing roles and authority, and the potential for unintended outcomes. Any implementation of GeoWeb 2.0 must be vigilant as new risks and requirements emerge. The advent of big, heterogeneous data creates problems of finding, assessing and integrating abundant information of various qualities. New uncertainties and bias arise from the publishing of information without traditional pre-publishing quality controls. Awareness of the emerging ways quality is often assessed post-publishing and expertise in these quality assessment methods are required. Organisations also require increasing resources to conduct quality assurance and semantically mediate, aggregate and synthesise big, heterogeneous information.

Participation is partial and uneven and the resulting information produced and shared is hence partial and not representative. The technology – computers, telephones, and internet connections – are not free. They and FGW2S are also constantly updated, and so require a continuing investment of resources to access and use. When Goodchild (2007a, p.214) stated that “the creation of a ‘fly-by’ was previously one of the more sophisticated GIS tasks, it is now possible for a child of ten to create one in ten minutes”, this is not any child of ten, but an educated child in socio-economic circumstances that ensure access to the necessary resources. GeoWeb 2.0 has reduced some transaction costs involved in creating, sharing and consuming information compared to previous media, but has not removed them entirely, and they are potentially displaced by new demands and risks.

While resources and perceived risks were important barriers to participation, motivation was identified as a countervailing force. Independent use of FGW2S by community group members shows that those motivated to participate and use GeoWeb 2.0 utilise available resources and

seek out additional assistance to address problems. This behaviour suggests they discount the relative importance of risks over benefits. This perspective is empowering to those with fewer relative resources.

The role of leadership was found to be an important factor influencing participation. This was at various levels: my own leadership, those within community groups, larger organisations and society overall. Leaders can influence the way GeoWeb is constructed, and whether and how others then actually participate. This role brings into question ideas of self-organisation and bottom-up emergence in complex adaptive systems that involve conscious actors such as humans. In this context, the attitudes of leaders are crucial and, while a global leader in technology recommended the Tasmanian government “believe” in the disruptive good of innovative technology, with this research I challenge such advice as unethical and dangerous.

People’s ability to participate in GeoWeb 2.0 is also constrained by a variety of structures operating at various levels. Each online application has an “architecture of participation” that allows some information to be shared in limited ways. These architectures reflect the worldview of the application creators regarding what information and representations are important. The ability to create applications is not evenly distributed and hence architectures of participation reflect the characteristics of the context that creates them. This can be the attitudes of people, or collectively those groups and organisations, which are then located within socio-political contexts with cultures consisting of resources, laws and norms.

It is my observation from this research that GeoWeb 2.0 does not, and is unlikely to support broad community sharing of environmental information. Claims that GeoWeb 2.0 has fostered a democratisation of information production through increased openness are then not supported. The vagueness of openness makes its use as an analytical concept problematical; potential alternatives are inclusive, representative, accessible, transparent, free, equitable, balanced (ing), collaborative, adaptable and reusable. GeoWeb 2.0 alone will not increase participation in environmental information sharing and sustainability efforts. My own experiences effecting change, and observations of others doing so through GeoWeb 2.0, suggest that effective participation is perhaps more important.

Through this research instances were demonstrated and described where the use of GeoWeb 2.0 for environmental information sharing contributes to environmental management and sustainability. If the types and range of initiatives identified herein were extended to be broadly

inclusive and comprehensive it could produce outcomes that are pluralistic, and environmental sustainability that is nuanced to a broad variety of perspectives and localities. Complexity theory, however, warns that with interconnected complex adaptive systems such as the environment and GeoWeb 2.0, judgement and analysis cannot be extended beyond the boundaries of the initial query or assessment. Increasing activities at limited local levels that combine and interact increase potential for unintended emergent outcomes at broader scales. My contribution to a local scale Food maps described in 7.4 contributed to the generation of a global Food map, when combined with similar local activities by others, a demonstration of what complexity theory describes as an unintended emergent outcome. Experiences of this research do, however, provide important perspectives on GeoWeb 2.0 that can guide further potential beneficial use for environmental sustainability. Motivation, leadership, focussed immediate short term goals and belief are factors that contribute to promoting effective participation within GeoWeb 2.0.

This research has contributed to an understanding of the potential implications of the emerging GeoWeb 2.0 and related practices for environmental information sharing, environmental management and sustainability. It has reviewed relevant literature in the context of Australian examples for environmental sustainability and in contrast to international developments. Importantly, it has shown that while many of the uses, effects and issues identified in overseas application and literature are relevant in Australia, they manifest variously in response to the local context. The descriptions of GeoWeb 2.0 applications and engagements in more specific and local contexts contribute to a more detailed and nuanced picture and understanding of the unfolding situation.

Part of the exploration has been to step back and consider the role of commercial interests, and particularly, to highlight ethical issues and the potential for negative impacts upon individuals, groups and societies, and so the need to be vigilant of who the winners and losers are. This provides a warning against universal or simplifying explanations of GeoWeb 2.0 and either its benefits or pitfalls. “Just believing” in deterministic or instrumental views of GeoWeb 2.0 is dangerous. Rather, I acknowledge the role of belief in creating visions of what is possible that motivate action, but assert that ethics dictates that this action must be continually and recursively critically examined.

10.2 Action Research and future research

The recursive processes and emergent design of Action Research are an appropriate and useful methodology for researching developments in the emerging GeoWeb 2.0 and relating to environmental sustainability. AR's dynamic matches and allows meshing with processes operating within these two subject areas. In this way, Action Research can respond and reflect changes in GeoWeb 2.0, broader environment and sustainability concerns and efforts. AR's broader bandwidth of quality legitimises the incorporation of diverse participation and ensures that such participation is ethical. Critical reflexivity is a useful method for examining subjectivity for both its contribution to knowledge and to personal growth and development.

Contributions to Action Research methodology from this research include insights into implementing PAR online using FGW2S, the importance of being open to offline participation when researching online, the use of multiple methods and how to address issues of informed consent in "natural" research settings. I found in this research an empowerment in the synthesis of the research subject matter and methodology, which allowed me to approach topics of personal concern in a manner that did not compartmentalise and hence marginalise parts of my experience and life. This breaking down of the barriers, of dichotomies between facts and values, research and action, field and not field addressed the totality of my experience as a person in relationship with others and our environment.

A problem with the research methodology as applied herein has been balancing making the research accessible through narrative, being transparent on methodology, position and hence construction, while also achieving thick description and hence validity. The narrative, trying to be clear about methodology has perhaps obscured research findings. Adopting a holistic approach has also prevented the thesis from delving into more depth in specific areas.

Future research classifying GeoWeb 2.0 activities into descriptive typologies could provide insights into the transformative or disruptive potential of not only Australian developments for environmental sustainability, but also broader applications. Measures of openness could be derived from a classification of the extent to which activities incorporate GeoWeb 2.0 features, such as APIs, folksonomy or creative commons licensing. Such a classification may also contribute to understanding the relationship between architectures of participation and the ontological viewpoint(s) of the platform creators. Additional classification criteria are the skill base of users, geographic context or the availability of ICT technologies.

Creating such classifications would need to address substantial issues. Firstly, little is yet published by the creators of such platforms, making the discovery of such factors largely reliant on secondary sources or specific targeted research. Secondly, the increasingly networked and interconnected nature of these activities presents difficulties for drawing boundaries between applications and categories. Lastly, GeoWeb 2.0 is a phenomenon that is not described consistently across the literature, as shown by the diversity of terminology used, disciplinary approaches and literature cited by many authors. Synthesis is required, to adequately define and describe GeoWeb 2.0 and allow communication across disciplinary siloes.

The role of emergency response and disaster management in the evolution of GeoWeb 2.0 deserves close attention, having influenced GeoWeb 2.0 developments due to the immediacy of information requirements. There is also a growing body of literature on VGI, GeoWeb and Social Media for the preparedness phase of disaster management (Haworth & Bruce 2015). Issues relating to disaster preparation and GeoWeb 2.0 have parallels with environmental sustainability due to the focus on building community resilience to external stressors and shocks. Emergency situations are, however, different to ongoing sustainability efforts, as in emergencies people can co-operate and are more open such that previous restrictions and rules are bypassed. If climate change results in increasing extreme weather with attendant emergencies, this may act to speed up the evolution of GeoWeb 2.0, in the same way that war has accelerated the evolution of other technologies. Processes such as GovHack can artificially create such “emergencies” as a means of speeding up innovation. The entry of commercial players into crowdsourcing in emergencies, such as described for the Nepal earthquake, requires careful consideration regarding ethical and political issues. How much and to what degree environmental information should be open for use is not simple, with priority issues being privacy, security, equity of access, intellectual property, who benefits and who pays? This will require continual consideration and reassessment as contexts change.

Addendum (2016)

This addendum is a response to my thesis examiners request to include more recent material, a special issue of *Geo* (Burns & Meek 2015) that touches on the politics of knowledge production in the Geoweb. The special issue of *Geo* was close to the time of my original submission and hence I have included this later material here as it constitutes hindsight. Sieber and Haklay (2015) discuss how the construction of the concept of VGI has separated the means of production and ends to legitimise truth, thereby ignoring the situated subjectivity of the knowledge created. This is the approach I have attempted in this thesis to make very transparent the context of its construction both in time and place, and in so doing draw attention to the context of creation of knowledge about the GeoWeb 2.0.

Continuing this theme of the importance of context, Johnson & Sieber's (2015) presentation of four models of open data recognises the multiple end points for which government open data can be positioned. They emphasise how the provisioning of open data to different sectors of the community requires the negotiation of tensions between ethical and economic drivers. When Bittner et al. (Bittner, Michel & Turk 2016) turn the spotlight on the crowd to examine the participatory ethics and practices of crisis mapping they question the extent such maps are bottom up representations from the wider community, echoing my concerns with Tomnod. Such considerations are all relevant to the initiatives considered herein, SenseT, GovHack, the WA EARS application, but it was not apparent (to an outsider) if or how such negotiations were undertaken and resolved.

Breen et al. (2015) identify where participants are limited to categorizing data or logging observations, the type of participation I observed in Australian Citizen Science GeoWeb 2.0 platforms, using the term "crowdharvesting" for where participants are framed "as a resource rather than as full collaborators" highlighting the "disparity in power over the framing, direction and interpretation of the research" (p.854). They aim for a type of Citizen Science which provides:

diverse constituents (the) ability to innovate past the limitations of traditional science, to question its assumptions, and to offer both a critique of and an alternative to the assumptions it makes (p.868).

In a similar call, Rufat (2015) uses the 2012 political crisis in Romania to showcase possibilities to raise the level of a participation from the production of data to the production of meaning

and political leverage through crowdsourcing geography and what they term guerilla cartography. It was this intent, also expressed in levels 3 and 4 of Haklay's (2013a) typology of Citizen Science, that I was seeking through openness in GeoWeb 2.0 applications for sustainability that could enable broader, in the sense of multiple ontologies and epistemologies, and hence deeper participation. While I did not achieve this in my research, Johnson et al. (2015) provide relevant insights with the observation of a "continuing gap between the promise of online geospatial technology, and the realities of its implementation at the community level". Their identification that the success of initiatives depended on "how researchers managed or continued many of the popular myths about the GeoWeb 2.0, namely that it is inexpensive and easy to use" echoes my difficulties and changing perspective.

The Geo issue illustrates how research on participation within the GeoWeb 2.0 is broadening and deepening, highlighting the potential issues and complexity, and providing rich empirical and theoretical resources to call on. McGall, Martinez and Verplanke (2015) argue we can learn from PGIS how to recognize, value and incorporate participatory processes into VGI to create the deeper construct of "Vulgar Grounded Intelligence". McConchie (2015) returns to the "utopian ideals of the Hacker ethic" as a means to understand participation in the GeoWeb 2.0, foregrounding the role of ideology and aligning with my observations of participants in the South Hobart Sustainable Community and GovHack, and hence the importance of the role of beliefs.

Such perspectives raise further problems for assessing the value of the information created through the GeoWeb 2.0. Antoniou and Skopeliti's (2015) review of VGI quality indicators concluded that the standard indicators used for authoritative datasets of completeness, logical consistency, positional, temporal and thematic accuracy, and usability are not always applicable. Factors of VGI contributing to this problem include its lack of specifications, homogeneity, and volatility. Of the standard quality indicators, they found usability the most applicable as it relates to the concept of fitness for purpose; and classified research into additional indicators under four groups that use the nature of the data alone, demographics, socio-economics and the characteristics of individual contributor's such as motivation, experience and local knowledge. Antoniou and Skopeliti suggest other methods may be the scope of VGI efforts or the mode of engagement. I suggest that we also need to consider the phenomenon being described, its level of discreteness (most OSM elements are highly discrete and hence quality is relatively less problematical), stability (highly mobile aspects are not easy

to assess for completeness) and hence density of observations and expertise may be more relevant, and subjectivity – is it a value such as the quality of a service.

Returning to the earlier question of whether the GeoWeb 2.0 constitutes a scientific revolution in information sharing in the sense of Kuhn, this unfolding research confirms it is too early to ascertain. Both the phenomenon and our understanding are still unfolding. It is doubtful those living at the time of the deployment of the printing press or the industrial revolution fully understood what was happening or could see the significance at the time. However, if it does, as pure conjecture I suggest the revolution is a paradigm shift for information organisation from categorical to context based, which changes our understanding of what constitutes knowledge.

Moving forward, I now understand a wide range of (academic) knowledge(s) available to the wider community that can be used to help understand and cope with this change. Few in my community are aware of or able to operationalise this knowledge. Since first submitting I have been approached by the Tasmanian Fire Service who thought that GeoWeb 2.0 platforms could be used to improve the resilience of Bushfire prone communities. I have also been approached to be a volunteer GIS Management Officer to help Red Cross provide GeoWeb 2.0 applications for post disaster response. I am now working again, this time for the Hobart City Council on bushland and reserves, and my colleagues are only just beginning to use interactive maps, their version of which is a one-way communication from the Council to the community. Raising the possibility of accepting community VGI causes raised eyebrows from senior management. My challenge now is to apply the knowledge learnt in this research. To assist in interpreting and translating academic knowledge into plain English; to provide more to my community than the advice to “just believe” in engaging and co-creating.

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A1 Appendix

Table A-1: List of SoOE wiki pages with PAR cycle and date created

PAR cycle	SoOE Wiki Page	Date created
1	About	21/02/2011
1	home	21/02/2011
1	Overview	21/02/2011
1	space.menu	21/02/2011
1	Map	23/02/2011
1	Senecio angulatus at South Arm, Tas	23/02/2011
1	The Sustainability Imperative	28/02/2011
1	Participate in the SoOE	7/03/2011
1	Theoretical and Research context	8/03/2011
1	What is Web 2.0?	8/03/2011
1	Proposed Outline of Topics	9/03/2011
1	The SoOE Sandpit	9/03/2011
1	SoOE Progress Reports	21/03/2011
2	The Geospatial Web 2.0, PPGIS and VGI	25/03/2011
2	Methodology	4/04/2011
2	Privacy and Rules	4/04/2011
2	Natone Hill Fire Management Plan	2/05/2011
2	Participatory Action Research	2/05/2011
2	Atlas of Living Australia	7/05/2011
2	Environmental GeoWeb 2.0 Portals and Platforms	7/05/2011
2	REDMAP	7/05/2011
3	Water	29/07/2011
4	Taxonomy or Folksonomy?	5/10/2011
4	Icons	11/10/2011
4	Presentation to 2011 SGES Conference	12/10/2011
4	Custon icons for Google My Maps	26/10/2011
4	Technology change	3/11/2011
5	BOM's 2011 Water Information briefings	22/03/2012

Figure A-1: Standard email invitation to collaborate from the SoOE My Map

I've shared a map with you called State of Our Environment (SoOE):
 You can view and edit this map at
<http://maps.google.com.au/maps/ms?hl=en&ie=UTF8&oe=UTF8&msa=0&msid=217568692591192122146.00049ce5c93a2be068ad3>

Table A-2: List of SoOE Map sites created in PAR 1

PAR	Site No.	Date	Site Name	Description
1	1	27/02/2011	Senecio angulatus	This is just a test Alister to see if the icon trick works. Yes Peter, I can see the icon but my map always opens centred on your Senecio location, does yours? Sure does, I wonder if this is because it was the first item put onto the map? Well looks like there are two ways to skin a cat!
1	2	28/02/2011	Shell fragments	A concentration of shell fragments and the soil is also darker in this area, I am wondering what this might be?
1	3	28/02/2011	Shell fragments	A concentration of shell fragments and the soil is also darker in this area, I am wondering what this might be?
1	4	28/02/2011	Shell fragments	A concentration of shell fragments and the soil is also darker in this area, I am wondering what this might be?
1	5	28/02/2011	Shell fragments	A concentration of shell fragments and the soil is also darker in this area, I am wondering what this might be?
1	6	1/03/2011	Significant tree - old Eucalyptus viminalis	This is probably the tallest old E. viminalis along the Esplanade and is quite often full of birds. The morning of the photo it was full of parrots and I tried to capture in the photo a large nest in the tree.
1	7	1/03/2011	Significant tree - old Eucalyptus viminalis	Old Eucalyptus viminalis or White gum. Significant amenity and habitat value. The Council has planted replacement trees along the waterfront across the road.
1	8	1/03/2011	Seat of contemplation	(https://picasaweb.google.com/lh/photo/z5EQ7_6hvroDadDnnnEZ5w?feat=embedwebsite) From Seats of Contemplation (https://picasaweb.google.com/112710630524165862583/SeatsOfContemplation?feat=embedwebsite)
1	9	8/03/2011	Revegetation at Lake Fenton car park	The revegetation at Lake Fenton car park was conducted by Greening Australia. I was the project manager at the time and I have a report somewhere I will see if I can upload it.
1	10	8/03/2011	Historic Heritage - Anglesea Barracks	Anglesea Barracks is listed on the Commonwealth Heritage List, significant as the oldest continuously occupied military barracks in Australia. It is owned and managed by the Department of Defence (http://www.defence.gov.au/environment/heritage.htm). The Barracks is open to the public, with a walking tour and brochures provided. The Military Museum (http://militarymuseumtasmania.org.au/main/) is open on selected days. More information is provided on the Heritage Register Listing
1	11	8/03/2011	Heritage Monument - Harkness Pillar	The Harkness Pillar was used to observe the transit of Venus.
1	12	8/03/2011	Significant tree - Blue gum	Old Blue gum or Eucalyptus globulus
1	13	8/03/2011	Significant tree - Blue gum	Old Blue gum or Eucalyptus globulus. This tree potentially predates the establishment of Anglesea Barracks. It is part of the Commonwealth Heritage listing for the site.
1	14	8/03/2011	Significant trees - Miena cider gums	There are three Miena cider gums or Eucalyptus gunnii subsp. divaricata seedlings planted along this embankment as part of efforts to preserve the species.
1	15	8/03/2011	Natural Heritage Site - Pontville Grassland	The Pontville grassland is on the Commonwealth Heritage List for its natural values

Figure A-2: Information provided on ways people could participate

Participate in the SoOE

The SoOE project is being conducted interactively and collaboratively right from the start. Firstly, this is to ensure the SoOE is useable by and relevant to the community, and secondly because change is happening so rapidly in these areas, it is the only way it will remain relevant. Below are some of the ways anyone can participate.

View

Just by reading these pages, you are contributing. Firstly, because the wiki records statistics on visits to the site which help to inform the design. You can view these statistics by going to Manage Wiki and clicking on Statistics. Secondly, you will think about the idea and this may plant a seed for further action somewhere else.

Share

If you like what you read, you can share this site with others you think might be interested.

Use

Due to the licensing of information on this site, you are free to use and remix any of it. You should acknowledge the source (that would be great thanks) and it would also be great if could you link from your work to this work.

Associate

If you think your work is of interest to this work, let me know and I will link to yours. You are also free to use the term State of Our Environment (SoOE) to associate any relevant work.

Collaborate

Yes, you can comment on, add to, or change most work on the SoOE. To assist in this process, I have create the "SoOE Sandpit", a place we can all play in to explore these ideas and create together effective community based environmental reporting.

Direct

You can contribute by suggesting how the research should proceed. See the Proposed Outline page and let me know what you think my next priorities should be or suggest a new one.

Support

Currently this work is supported only by scholarship funding, and I am open to offers of support from interested individuals or organisations. Contact myself or any of my supervisors for further information on how.

(Source: <https://stateofourenvironment.wikispaces.com/Participate+in+the+SoOE>)

Figure A-3: SoOE Map “Invite collaborators” panel.

[Get directions](#) [My places](#)

Collaborate

State of Our Environment

The SoOE map is part of a PhD r investigating how to harness Wet facilitate broad based community reporting. It is open to anyone to areas of interest and related info information see the SoOE wiki: <http://stateofourevironment.wikis>

Public · 18 Collaborators · 3,937 views
Created on Feb 22, 2011 · By Al Clark

★★★★★ 1 ratings · 1 comments · KMJ [8+1] [0]

- Bridal Creeper
I found 3 bridal creeper vines here Aug corms and placed them up in a dead cal sign about the Eastern Barred Bandicoot
- Revegetation at Risdon Prison
The revegetation project was completed Austrailia. It was part of the recent rede involved the prisoners in the work which rew...
- Biggenden Big Wet Jan 2013, Ph
Photo 1 looking NNW across what were along creek visible on left. From Biogen

Invite collaborators

[Invite people as collaborators](#)

Separate email addresses with commas

Message:

I've shared a map with you called State of Our Environment (SoOE):
<http://maps.google.com/maps/ms?ie=UTF&mmsa=0&msid=217568692591192122146.00049ce5c93a2be068ad3>

Add your message (optional)

[Send invitations](#) ☐ Send me a copy of this invitation

Manage collaborators

Advanced Permissions
Only the owner may change these settings

☒ Collaborators may invite others


☐ Allow anyone to edit this map

Collaborators (18) - [remove all](#)
Collaborators may edit the map.







Me - owner	<div style="float: right; text-align: right;"> </div>
------------	---

[OK](#)

Figure A-4: SoOE Wiki, Water page, first writing (more below is later addition)







State of Our Environment

 Wiki Home
  Projects
  Recent Changes
  Pages and Files
  Members
  Settings

Welcome to the SoOE
 About the SoOE
 SoOE Overview
 Introduction

The Sustainability Imperative
 What is Web 2.0?
 The Geospatial Web 2.0
 Environmental GeoWeb 2.0
 Portals and Platforms

 Water

 Edit
  0
 

Water

This page is about water - use and wastage, quality and pollution. I started it with observations of what I think must be either wastage and or pollution occurring at a stormwater drain outlet. The location of the issue is shown [here](#). Many mornings I have noticed strong water flow from a stormwater drain outlet into Lindisfarne Bay on the Derwent Estuary. I notice it at around 0800, and it is unusual because no other stormwater drains are flowing at the same time so I do not think the flow is related to natural events. It is also very regular, occurring at approximately the same time. I conclude it must be either a leaking water supply pipe (but why the regularity?) and hence an instance of wastage, or a discharge of waste water into the stormwater system and hence potential pollution. I have traced the sound of the flow uphill as far as possible, shown on the map with the line linking identified stormwater inlets. (note that this line was removed during somehow when I was using the map, I'm am not sure how, it may have been that I did not save my edits properly). It appears the source is somewhere just below the East Derwent Highway in the vicinity of the block contained by Lincoln and Milford Streets and the East Derwent Highway.

Table A-3: SoOE Map sites added in PAR 2

PAR	Site No.	Date	Site Name	Description
2	16	29/03/2011	Revegetation Project	The revegetation at Lake Fenton car park was conducted by Greening Australia. I was the project manager at the time and I have a report somewhere I will see if I can upload it.
2	17	3/04/2011	Senecio angulatus	?
2	18	3/04/2011	Brown Bandicoot sighting	This is just a test Alister as you said you couldn't add text to this placemark? Seems OK now? Yes Peter it was a short term glitch. I obviously now have to try to remember the details of this sighting most importantly the date, it will be in my diary somewhere. There are many signs of Bandicoot activity all along this foreshore.
2	19	3/04/2011	Pollution source - stormwater outlet	This is a stormwater outlet, a potential pollution source into the Derwent Estuary. Are these being monitored by anyone. See also the point across the road regarding water wastage
2	20	20/04/2011	Sentinels of bus stop 68	Lovely old blue gums towering over the bus stop. I agree, I drove past them about a month ago after you told me about them. But I think you have to see them from the ground to appreciate their age. 24/10/11
2	21	30/04/2011	Significant Trees	Yesterday (1/5/2011) this tree was full of birds, mainly a small green parrot with a yellow stripe along its shoulder. I am colour blind so identification of anything coloured is not my strong point. The birds were feeding on the flowers. These trees are great habitat. They are Eucalypts but I am not sure what species, they look planted.
2	22	1/05/2011	Brown Bandicoot sighting	A few days ago a Brown Bandicoot was out foraging here in the middle of the day. We walked and stopped right adjacent to it on the bike path, and it kept feeding every so often stopping to look at us. I am amazed they persist here given the amount of cats and dogs around, and are so fearless. It shows the value of the native shrub plantings along the foreshore. I think we have Phil Watson at Clarence Council to thank for that. Well done!
2	23	1/05/2011	Stormwater discharge	I have noticed unusually high discharges from this stormwater drain on several of my early morning walks, at around 0600. I am wondering where this drain leads from and where this water could be coming from?
2	24	2/05/2011	Natone Hill Fire Management Plan	A fire management plan for Natone Hill is available from the Clarence Council web site (http://www.ccc.tas.gov.au/webdata/resources/files/Natone_Hill_FMP_2010_draft.pdf). It would be great if they could make it available for comment by putting it in a wiki and posting the spatial files onto a platform such as this. I have put some on the SoOE Wiki (http://stateofourenvironment.wikispaces.com/Natone+Hill+Fire+Management+Plan)
2	25	9/05/2011	Revegetation at Risdon Prison	The revegetation project was completed while I was with Greening Australia. It was part of the recent redevelopment of the prison. We involved the prisoners in the work which was a challenging but rewarding experience. Everytime I drive past the prison I am extremely proud of this project and how it is progressing. you can view photos here (https://plus.google.com/photos/117221524180580118478/albums/5876187444591976193)
2	26	9/05/2011	Arm End	Opossum Bay Coastcare group with assistance from South Arm Primary School, Conservation Volunteers Australia and the Friends School planted about 950 plants in the Arm End area; this planting of around 450 plants included: Blackwood, White and Silver Gum, as well as Ahkly Box and other species over an area of around 4500M ² .
2	27	13/05/2011	Ashgrove Cheese	This was my correction of the location on Google Places
2	28	24/05/2011	Ashgrove Cheese	Ashgrove milk available in Woolworths supermarkets - is this the most sustainable option available? Its local, you can identify where it was produced, a family business, but it is more expensive. What do you think?
2	29	24/05/2011	Water waste?	I often notice the sound of water when I walk past this manhole cover on the stormwater drain, which seems strange and I am wondering if there is a leak in the distribution supply somewhere nearby? My next job is to send this link to someone in Southerwater. Noticed water running again on Monday (22/5/11) morning
2	30	4/06/2011	Natural Heritage Site	The Pontville grassland is on the Commonwealth Heritage List (http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=place_name%3Dpontville%3Bkeyword_PD%3Don%3Bkeyword_SS%3Don%3Bkeyword_PH%3Don%3Blatitude_1dir%3DS%3Blongitude_1dir%3DE%3Blongitude_2dir%3DE%3Blatitude_2dir%3DS%3Bin_region%3Dpart;place_id=105455) for its natural values.

Table A-4: Sites added to the SoOE Map in PAR 3

PAR	Site No.	Date	Site Name	Description
3	31	20/07/2011	DRAIN_Lindisfarne_21Jul11	Again this morning this drain was running at 0630ish. I had my GPS so I logged a waypoint and then upload it to GEarth from which I then emailed a KMZ to my other computer and uploaded this one to GMaps, so the accuracy of the initial placement looks pretty good. Now is this a water wastage or pollution issue?
3	32	5/08/2011	Sea Level Rise Coastal Erosion	This is the location of the coastal erosion monitoring described in this document
3	33	30/08/2011	Water wastage / pollution?	At about 0600 on 30 Aug 11 this stormwater drain had water flowing in it. It is directly up hill from the drain on the edge of Lindisfarne Bay
4	34	11/10/2011	School of Geography and Environmental Studies	My presentation to the annual School Conference can be found on the SoOE Wiki page here

Figure A-5: Journal page 99, 12 July 2011, trialling different GPS software

- Downloaded GPS files using DNRGarmin set to Port 1 and 9600. Could not open in GPS Utility, or BaseCamp.
 - Saved file as a GPX - 43 waypoints
 - Could not open easily in ArcGIS or ArcGIS.com.
 - But opened easily in GEarth - I organised the waypoints into folders and added some descriptions
 - You can "fly to" a place by right clicking it and selecting properties. The description appears in the Table of Contents
 - To put ~~it~~ the waypoints into folders I had to individually drag each one, I could not drag multiple ones.
 - I then saved them to my places folder. After this I wanted to view them in GMaps (better in Google Chrome) but they did not appear and I think this might be because I had not saved My Places yet. I will ~~on my computer~~
 - ? My question is when I save them as My Places, where is the data stored, on my computer, or on Google? I would like to save and organise my own files, but not sure if My Places is actually a folder on my computer or not.
 - I saved the tracks in various formats using DNRGarmin - in CSV-text, .kmz, .shp .gpx to see the differences

Table A-5: SoOE Wiki files created in PAR cycle 4

4	Folksonomy vs Taxonomy.pptx	file	5/10/2011
4	Folksonomy vs Taxonomy v2 text only.docx	file	5/10/2011
4	Eucalyptus_camaldulensis_river_red_gum__(3).png	file	24/10/2011
4	Eucalyptus_camaldulensis_river_red_gum__4.png	file	26/10/2011
4	Eucalyptus_spp._Eucalypt_1.png	file	26/10/2011
4	Eucalyptus_camaldulensis_river_red_gum__(2).png	file	26/10/2011
4	E_vim_Rose_Bay_Esplanade	file	26/10/2011
4	FILE0053_Sketcher_1.png	file	26/10/2011
4	Euc_vim.png	file	26/10/2011
4	PGradConfPosterPresentWrapup.docx	file	3/11/2011
4	SoOE_Report_4_AugSeptOct11.docx	file	4/11/2011

Table A-6: Site added to SoOE Map in PAR 4

PAR	Site No.	Date	Site Name	Description
4	34	11/10/2011	School of Geography and Environmental Studies	My presentation to the annual School Conference can be found on the SoOE Wiki page here (http://stateofourenvironment.wikispaces.com/Presentation+to+2011+SGES+Conference).

Table A-7: Files added to the SoOE wiki in PAR 5

PAR	Title	Type	Date added
5	BOM's 2011 Water Information briefings	file?	22/03/2012
5	WorldinOurHands_v2_21Feb12.docx	file	23/03/2012
5	A_Clark_Masterclass_sub_27Feb12.docx	file	23/03/2012
5	SoOE_Update_Report_No5_NovDec11_FebMar12.docx	file	27/03/2012

Table A-8: Site added to the SoOE Map during PAR 5

PAR	Site No.	Date	Site Name	Description
5	35	16/03/2012	Water leak update 16/3/12	Since identifying this leak, I have contacted Southern Water and they have remedied the leak. I have written about this on the SoOE Wiki page Water (http://stateofourenvironment.wikispaces.com/Water). The low flows now show clear evidence of pollution loads, such as car washing discharge, noted on 14/3/2012.

